HILLS and VALLEYS of TORQUAY

1. Torquay, Eng. — Geography, Physical

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THE HILLS AND VALLEYS OF TORQUAY.

Plate I. Lincombe Hill and Wellswood from the East, with Warberry Hill in the distance.

THE

HILLS AND VALLEYS OF TORQUAY

A STUDY IN

VALLEY-DEVELOPMENT

AND AN EXPLANATION OF

LOCAL SCENERY

BY

A. J. JUKES-BROWNE, B.A., F.G.S.

AUTHOR OF 'THE BUILDING OF THE BRITISH ISLES' [illegible]

'STRATIGRAPHICAL GEOLOGY,' ETC., ETC.

WITH [illegible], SIX MAPS, AND [illegible] IN THE TEXT

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TORQUAY 1907

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ERRATUM.

p. 46, *top line.* The spring of St. Efrides Well rises near old Torre Church, not by All Saints Church, and it is doubtful whether the water from it flowed down Mill Lane, though this lane was certainly a water-way.

PREFACE.

THIS little book has been written with the view of explaining the origin and gradual development of the physical features which contribute so largely to the popularity and attractiveness of Torquay. Those who reside here are of course, more or less familiar with the local scenery; the town has spread itself over so many hills and dales, that it is a scenic study in itself, and visitors are generally struck with this aspect of Torquay. Sir W. Besant, for instance, is said to have remarked—"It is always a joy to walk about Torquay," and he also expressed a wish that he could have seen its hills before they were built over.

I think there may also be some, both of residents and visitors, who wish to know something about the history of our hills and valleys; some, perhaps, who have wondered how Torquay came to be such a hilly place that it is difficult to find a flat piece of ground in the whole town, except where the surface has been artificially levelled up or levelled down; some again who have wondered why the surface of the ground throughout Babbacombe and St. Marychurch is so flat that no eminence rises above its level between Petitor and Warberry Hill. Others again may have noticed

that all the chief valleys and watercourses run from north to south and open into Torbay, instead of running from west to east, as they might have done.

These are not idle questions, but points on which definite answers can be given. All our hills and valleys and plains have had a history; they have gone through a regular process of growth and development, which can be followed and realized by anyone who has some acquaintance with the physical geography and geological history of Devonshire.

It has been my aim to supply the reader with just that amount of geological information which is necessary to understand an explanation of the manner in which our hills and valleys have been formed. I have endeavoured to express myself in clear and simple language, using as few technical terms as possible, and explaining those that are used, so that each chapter may be readable in itself as well as conducive to the understanding of the next one.

I have had much difficulty in obtaining photographic views that would illustrate the features described in the text; consequently most of those reproduced in the plates have been taken specially for this purpose. They must be regarded as illustrative and not as artistic photographs. Plates I., III., and VII., are from views taken by Mr. H. Spicer of Chelston, but VII. suffers from having been taken in the winter.

Plate IV. is from a photograph by my friend Mr. W. Hill: Plate V. is reduced from an old drawing, and Plate VI. is from a photograph taken by Mr. T. S. Waymouth of St. Marychurch.

The maps also require a few words of explanation. The basis of Fig. 1. was a clear print of the old Ordnance Survey map of 1809 obtained directly from the Ordnance Office. Figs. 6, 8, and 9, are portions of the new six-inch Ordnance maps converted into geological maps by the superscription of line-patterns to represent the areas occupied by different kinds of rocks. The geology is based upon that of the Geological Survey maps, but since that Survey was made, many new roads have been laid out and many excavations made for various purposes, so that much fresh evidence is available. During the course of 1906 I collected some of this evidence, and resurveyed considerable areas on the six and 25-inch Ordnance maps; being assisted in this work by my friend Dr. H. Humphreys, whose aid I gratefully acknowledge. It is from the maps thus constructed that Figs. 6, 8, and 9 have been prepared, and coloured copies of the six-inch maps have been deposited in the Museum of the Torquay Natural History Society. Figs. 4 and 10 are enlargements from the Geological Survey map slightly altered in some details.

For permission to use the diagrams Figs. 7 and 11. I am indebted to the Council of the Geological Society,

If I have the good fortune to interest some of my readers in the general subject of Hills and Valleys, so that they may wish to learn something of the history of greater hills and valleys than are to be found within our little district, let me recommend them to read two excellent books, first "The Scientific Study of Scenery," by Dr. J. E. Marr (Methuen & Co., 6/-), and secondly, "The History of Devonshire Scenery," by Mr. A. W. Clayden (J. G. Commin, Exeter, 10/6).

A. J. JUKES-BROWNE.

FLORISTON,
TORQUAY.
April, 1907.

CHAPTER I.

Introductory Considerations.

Contents. — The Hills of Torquay. Contrast between Torquay and Brixham. Popular Fallacies. Formation of Valleys. The Rocks which form the Brixham Plateau and the Torquay District.

It was the boast of ancient Rome that the city stood on seven hills, but in this respect Torquay can claim still greater distinction, for our town spreads over no fewer than eight hills, some of which are higher than those of Rome. On the southern front, presenting bold precipices to the Bay, are three fine hills: Waldon Hill, rising above the well-known "Rock Walk" to a height of 200 feet above the sea; Vane Hill and its prolongation into Daddy Hole Plain, which are both more than 200 feet high; lastly, the wooded and winding slopes of Lincombe Hill with its high central ridge which reaches an elevation of 400 feet above the sea. North of the last is the long ridge of Warberry Hill, the summit of which is the crowning height of Torquay (448 feet), and from it descend the western spurs which are known as Braddons Hill and Stentiford's Hill. Beyond these, to the north-west, are the smaller eminences of Castle Hill and Torre Hill. These are the eight central hills, but the town really

Fig. 1. General Physical and Geological Map of the District.

Reproduced from the Ordnance Survey Map of 1809 with the sanction of the Controller of H.M. Stationery Office.

spreads over two other heights;—the plateau which extends from Chapel Hill on the west to Tor Vale on the east, and the high ground of Upton Hill and Bronshill, all three being more than 200 feet above sea level.

Some of these hills are shown on the map Fig. 1, which is a combined physical and geological map of the country near Torquay, based on the old Ordnance map of 1809. This map is interesting not only because it shows how small a place Torquay was at the beginning of last century, but also because the physical features are seen more clearly than on the modern Ordnance maps in which the hill-shading is obscured by the network of roads and houses.

Torquay indeed is justly celebrated for the beauty of the site on which it stands, and it is unquestionably its hills which by their variety of outline constitute its chief scenic beauty; but these hills owe their height and boldness of feature to the deep valleys by which they are separated; for, if there were no such valleys, the hills would be mere hummocky elevations rising from a more or less level plateau. This statement embodies a great truth in physical geography, for (as we shall presently see) most hills are hills because of the valleys and combes which have been formed between them.

In the matter of picturesque scenery there is a curious and striking difference between the tracts of country on the northern and southern sides of Torbay. The country round Brixham is a plateau which is traversed by a single narrow valley; the land on each side of this valley being merely an undulating plain,

devoid of any special beauty or variety. Around Torquay on the other hand the country is trenched by a number of deep and curving valleys, between which are a series of hills and ridges, varying in height, direction and shape.

It is mainly this double series of curves in the outline of the ground,—the curves in the horizontal plan of ridge and valley, as well as the curves in the vertical contour of the slopes, which makes such scenery so interesting and attractive to the eye. Doubtless many of those who reside in Torquay and of those who have visited our town have recognized more or less fully that it is in these features that the essential beauty of Torquay lies. Some also may have been struck with the contrast which I have indicated between the country around Brixham and that around Torquay, and they will have perceived the absence of alternating ridges and vales in the case of the former district; but I expect that few would be able to realize the reason for the absence of such features.

The real cause of the contrast is the difference in geological structure, but few people realize that this is the case, for there are few schools in which either Geology or Physical Geography is taught, and consequently very few people have any knowledge of the structure of the island in which they live, or of the manner in which its surface features have been developed. By the lack of this knowledge many otherwise well-educated and well-read people miss a great deal that is both interesting and useful.

As Dr. J. E. Marr has recently observed, "it is as an aid to the appreciation of the beauties of nature that

the study of physical geography differs most markedly from that of other sciences which are usually taught in schools. The artistic temperament may appear to have little to do with the spirit of scientific enquiry; but one usually finds that the lover of natural beauty has an insight into the meaning of the objects which call forth his admiration, and at all periods of human history, the lovers of nature seem to have had a desire to explain what they saw, though the craving for explanation in early days often gave rise to speculations far removed from the truth. The appreciation of natural beauty has undoubtedly spread greatly in our country within recent times, and the desire to know something of the changes which brought about the present scenic features is equally marked. . . The author of *Modern Painters* has written chapter upon chapter with reference to the importance of our subject to the lover of scenery, for, as he observes, 'the real majesty of the appearance of the thing to us depends upon the degree in which we ourselves possess the power of understanding it.'" *

Now when Physical Geography is properly taught, it includes some of the knowledge which is generally regarded as belonging to the Science of Geology. It does not matter under which title the knowledge is imparted, and if I can succeed in explaining the way in which our local valleys and hills have been formed without wearying the reader with too many technical terms and dry details, I think he will admit that Geology is capable of imparting a special interest to

*** See article on The Study of Physical Geography by Dr. J. E. Marr, in "Science Progress," No. 1, p. 33 (1906).**

the physical features of any locality in which it may be his fortune to live.

Before, however, we proceed to explanations, it will be desirable to clear the foreground of some obstacles which may hinder their acceptation. These obstacles are certain popular fallacies. One such fallacy was for a long time an article of religious belief, and was a great difficulty with many during the first half of the last century. This was the supposition that the world was created about 6000 years ago, and created moreover just as we see it now, with the existing continents and the existing oceans.* At the present day few thinking people are troubled with this fallacy, and the philosophers are now only concerned with the number of millions of years which can be allowed to geologists for all the successive phases or chapters of the Earth's history which their researches have revealed.

After all, the geologist is much more modest in his requirements than the astronomer; the latter demands far greater distances in miles of space than the geologist does in years of time. Astronomers make us believe in a solar system which is 5585 millions of miles in diameter; and this, our little system, is only a very small portion of stellar space; Geologists, on the other hand, can be contented with about 90 millions of years for their History of the Earth since seas first condensed upon its surface, and the "record of the rocks" thus began.

* It should be more generally known that the Alexandrian era, which was accepted by the early Christian writers, fixes a very different date for the Creation of the World, viz., 5,502 years B.C., and that approximately the same date (5508) is still used by the Greek church.

As a prelude, therefore, to subsequent explanations, I must ask for a liberal draft upon the Bank of Time, and also for the right to assume the accomplishment of many changes and transformations by the slow operation of various natural causes. This brings us to another popular fallacy. No doubt many of my readers are familiar with the expression "convulsions of nature." It is a phrase often used by travellers who record their impressions of certain striking natural features, such as a deep ravine with vertical walls, a mountain-precipice, or some isolated pinnacle of rock. They imagine that the ravine has been produced at one stroke by some convulsion which rent the rocks asunder. If there is a river at the bottom of the gorge, they probably think that the water flows that way because a passage was made for it, and do not dream that the passage was really made by the river itself.

Now, it is true that in volcanic districts small "convulsions of nature" may be said to occur, and volcanoes certainly make hills by the ejection of lava and ashes; but valleys are not made by volcanoes, and very seldom by earthquakes, for such small cracks as are sometimes opened by earthquakes are generally soon filled up again by the soil and stones which are washed into them. Moreover, since deep ravines, gorges, or "cañons," are common in almost every country, and only differ from one another in depth, length, and minor features, the agency by which they are produced must be one that acts effectively in all parts of the earth.

Modern Geology teaches us that the rain which falls on the surface of a country, and the streams into which

it gathers, are the agencies by which valleys and ravines are made. It has, therefore, become an axiom among geologists that every valley has been formed by the stream which now runs through it, or by some stream which did formerly run along it. This being so, it needs little consideration to perceive that there must have been a time when the valley did not exist, and when the watercourse was merely a shallow channel on the surface of a plateau which was nearly level with the ridges lying on each side of the present valley.

The principles involved in the preceding remarks may now be stated in a more definite and formal fashion, with the object of impressing them on the mind of the reader, who should bear in mind that:

1. Geological time is a vast vista of years, the length of which is comparable to the distance in miles between the earth and the sun.

2. The phrase "a convulsion of nature" is no explanation of natural phenomena, but merely a confession of ignorance.

3. In countries where there are no mountain ranges nor any active volcanoes, subterranean forces have had little share in shaping the present features of the land.

4. In such countries the hills have been formed by the removal of surrounding material. The actual height of their summits has been determined by the uplift which raised the country above the sea, but their existence as hills, and their elevation above the surrounding valleys and plains, are the result of long-continued erosion and detrition.

5. *Erosion* means, "eating out" of rock material; thus waves erode cliffs; rivers erode or excavate their

channels. *Detrition* means, the wearing down of the land surface under the combined action of all subaerial agencies, such as rain, springs, frost, wind, and the sun's heat.

6. All valleys and ravines have been formed by the erosive action of rain and running water.

7. The courses of the streams and the positions of the intervening hills have been determined, partly by such surface slopes as existed when the land was last raised above the sea, and partly by the relative hardness of the rocks composing it.

It thus becomes clear that if other conditions are equal, soft materials like clay and shale will be worn away more rapidly than hard rocks like limestone and granite; consequently if a district consists of several different kinds of rock, some portions of it must be worn away more rapidly than others, leaving the harder masses to stand out as hills. On the other hand, if a tract of country consists of one kind of rock in considerable thickness, such a tract is not likely to have a diversified surface, but will form a plain or plateau, interrupted only by a few watercourses or valleys.

We may now return to the comparison of the country around Brixham with that around Torquay. The map of the Geological Survey shows that the country around Brixham and Churston consists almost entirely of limestone; such rock extending from Berry Head to Churston Station, and from the Torbay coast for a distance of about a mile to the southward. South of this band of limestone is a parallel, but narrower band of slate, backed by an irregular ridge of harder rocks

which form high ground rising to heights of 400 and 500 feet above the sea.

As a consequence of this comparatively simple structure, the ridge on the south forms the local watershed, while the slates and the limestones formed originally a merely continuous slope toward the north or north-east. Down this slope ran two little streams which, uniting near the edge of the limestone tract, ran over it and gradually excavated the valley in which Brixham town and harbour are situated. This is the only valley which traverses the limestone tract, the rest of it forming a nearly level plateau, the surface of which is for the most part from 170 to 200 feet above the sea.

Very different is the structure of the country around Torquay where a number of different kinds of rock come to the surface.

The following are the chief kinds :—

Shales and shaly slates.
Hard gritstones (fine grained sandstones).
Hard limestones and massive marbles.
Soft red clay.
Hard red conglomerate.

Moreover, although these rocks were originally laid down in a regular order of succession, they have since been so bent and folded, so broken and dislocated at various times, that the whole area is cut up into small tracts of different kinds of rock, the boundaries of which are abrupt and often run in nearly straight lines. Thus the rock masses which underlie Torquay and Marychurch may be compared to the pieces of a Chinese puzzle which have been fitted together into some irregular pattern.

The reader will now understand that when such a district is exposed to the wear and tear of the erosive and detritive agencies above indicated, its surface is likely to be sculptured into an irregular series of hills and vales, and thus contrast very strongly with a district which is composed of one or two kinds of rock.

Much, however, still remains to be explained. Anyone who has an enquiring mind will want to know how the courses of the valleys were first determined, and why some of them cut through hard rocks as well as soft; why some valleys are occupied by streams and others are not; why certain valleys seem to have cut through hills instead of going round them; why some streams rise near the coast and flow away from it instead of taking the shortest course into the sea. All these questions can only be answered by a careful study of the locality, combined with some knowledge of the geological changes which it has passed through.

CHAPTER II.

Contents. — Drainage Areas and Watersheds. Boundaries of the Torquay District. Peculiarities of the Watershed. The Valleys within this District. Original aspect of the Fleet Valley.

It was stated in the previous chapter that in an area where different kinds of rocks come to the surface, the softer kinds are worn down into hollows and depressions, while the harder masses become hills; but though this is true as a general rule, it must not be taken to mean that hard rocks are never found in the valleys of such a district. The production of hills and valleys is the result of a long process of development, during which a regular system of river-drainage is formed; each drainage-area being separated from its neighbours by a watershed, and having within it subsidiary watersheds dividing valley from valley.

The directions and courses of the valleys were determined by the courses of the streams when they began to run over the original surface of the land. The courses of the valleys again determined the positions of the dividing watersheds, and it is only portions of these watersheds which become hills. Thus the initiation and gradual development of the valleys constitute the key to the physical features of a country.

Now in order to understand the origin of the valleys

of any given area of drainage, we must first mark the course of the main line of watershed, note the courses of the tributary valleys and the direction toward which they converge. We must next consider the geological structure of the district, and by the restoration of such beds or formations as may have been removed from its surface during past periods of erosion and denudation, we must endeavour to realize the ancient surface of the country on which the valley-courses were originally established.

The Torquay district is curiously situated with regard to the principal watersheds of the country, for it does not lie within any of them, but has a little drainage system of its own which is now quite independent of the large drainage systems of the Dart and the Teign. This arrangement, however, is undoubtedly due to the continued inroads of the sea by which Torbay has finally been formed. In ancient times, when the land not only extended over Torbay, but over most of the Channel area as well, all the little streams which now empty themselves into Torbay were but the tributaries of a river which was itself in all probability a tributary of the Dart.

At present, however, we are only concerned with the Torquay district and with the watersheds which form its boundaries. These are shown on the general map of the district (Fig. 1). On the north we find a well-marked watershed ridge dividing the waters which drain directly into the Teign from those which run southward into Torbay. This ridge starts on the east coast near Watcombe, and passes westward through and above Watcombe Park; it then branches into two

ridges, one trending to the north-west, and the other to the south-west by Barton Cross and Barton Hall, but it is a curious fact that the actual water-parting is not now continued along either of these two ridges, for the brook in the valley west of Barton runs into the Aller stream at Kingskerswell and so into the Teign. The present continuation of the watershed from Barton Cross is along the high road west of Barton to Smale's Nursery, and then southward to the Gas Works, near Hele Cross. Thence it passes westward to Lowe's Bridge where the road to Newton is carried over the railway, and from this point it runs by Shiphay to the high ground south of Edginswell.

There are two curious features about this part of the watershed, first, it runs along lower ground than the Barton Hall ridge which seems the natural continuation of the Watcombe line of water-parting, part of it being also lower than the ground to the eastward, *i.e.*, Lummaton and Yaddon Hills; whereas a watershed generally includes the highest tracts of land between two systems of valleys. Secondly, this portion of the watershed is not even a continuous ridge or plateau, but is completely breached by the dry valley through which the road and rail pass northward from Torre Station. This valley is truncated by that of the brook which rises in Hatchcombe near Barton, and the highest level in it is at Lowe's Bridge, where the ground is only 165 feet above the sea.

Reference to the modern Ordnance maps shows that the Barton Hall ridge sends out a spur southwards from Fluder which brings the contour line of 300 feet within 330 yards of the main road opposite Edginswell.

South-west of that village the ground again rises to 400 feet above the sea and passes southward into a ridge which for some distance forms the watershed between the drainage area of the Dart and that of little streams which flow into Torbay. This ridge reaches an elevation of 500 feet between Marldon and Cockington, and thence it continues southward by Five Lanes and Windmill Hill (515 feet) to Kings Aish, whence it curves eastward and runs out to sea in Roundham Head near Paignton.

The several lines of watersheds above described are indicated by a pattern on the map (Fig. 1), and from this it will be seen how curiously the boundary watershed of the Torquay district is deflected by Shiphay and Hele to Barton, instead of being continued across the valley at Edginswell to join the Barton Hall ridge. This deflection of the watershed line suggests the idea that the Aller brook has somehow worked its way through the original watershed of the Torquay district, and has captured part of the natural water supply of that district. In a future chapter I shall discuss this point more fully, and shall give reasons for concluding that such an encroachment has actually taken place, and that the Barton Hall ridge was originally part of the main line of watershed.

Let us now concentrate our attention on the area which lies within the boundaries above indicated and briefly enumerate the valleys by which it is traversed. I do not propose to say anything about the little watercourses near Paignton, all of which are very short, but shall deal only with those which drain the country round Cockington, Torquay, and St. Marychurch.

Commencing on the west we have first the Cockington valley, the general direction of which is from north-west to south-east. The head of this valley lies in the high ground about a mile north-west of Cockington, and its total length is less than two miles, yet in this short distance it descends through a vertical height of more than 200 feet. The valley is chiefly remarkable for its steep wooded slopes, which in many places are little altered from their original condition. The higher part of the valley is only a watercourse after heavy rain, but springs issue at several points in Cockington village and form a rapid little brook which runs into the sea at Livermead.

The next valley to claim our attention is that of Torre, which is shorter than the Cockington valley, being only a mile and a half in length; but the fact is that the Torre valley has no real head or main source, for it commences as a depression in the watershed by Lowe's Bridge, on the Newton road, where the ground is only 165 feet above sea-level. From Lowe's Bridge it runs southward with a very gentle incline, both main road and railway being carried along it so that it forms the natural entrance to Torquay from the north. This part of the valley is deep and narrow, but south of Torre Station it widens out, springs issue at several points, and the central valley-way is a tract of flat alluvial ground extending from near Pilmuir, through the Rosery gardens and the recently constructed King's Garden to the shore of Torre Abbey Sands. This Torre valley is only a remnant of a much longer valley, for, as we shall see in a future chapter, it has been curtailed at both ends.

We now come to the valley which runs through Upton and the central part of Torquay, for the stream by which it was formed ran originally down Union Street and Fleet Street, and emptied itself into the little bay which is now the harbour. The lower part of this stream was called the Fleet, and we may find it convenient to apply the name to its whole length, since it does not seem to bear any special name in the higher part of its course.

The sources of this stream are on the slope of the main watershed, north of St. Marychurch, to the south and west of Watcombe Park, and its valley has a total length of about three miles. Its eastern sources gather into a brook which runs through Watcombe Terra-cotta Works; the western sources are derived partly from rain-water which flows off the clay-slopes north of Barton, and partly from springs which issue on the south side of that hamlet. The two brooks unite near Marychurch, and the Fleet then enters the well-marked valley which lies between Marychurch and Lummaton Hill, passing southward into the rocky gorge which lies between Daison and Yaddon Hills, and is known as Combe Valley. Emerging from this, it runs through Upton to Castle Corner, and thence the valley-way is continued by Union Street and Fleet Street to its termination at the Strand; though these streets are now raised above the old valley floor, and no running water is seen in them.

Before the town of Torquay, or its primitive nucleus the village of Fleet, was in existence (*i.e.*, less than 200 years ago), this valley was in its natural state, and to anyone looking into it from the seaward end it

presented a picturesque vista of steep wooded slopes and rocky crags, while its bottom was occupied by a swift flowing brook which emptied itself into a little tidal inlet opening out of the Tor-quay bay.

At the beginning of the 18th century there were no houses on the western side of the valley, and only a few on the eastern side, the chief of which was Fleete Mill, a view of which taken in 1780 is given in White's History of Torquay (p. 113). This mill stood at the back of what is now the Union Hotel, and the Millpond was just above this and below the opening of Market Street, which was then a lateral ravine, carrying a little tributary brook from Ellacombe.

Mr. J. B. Swete, writing in 1780, and quoted by Mr. White says, "the village or town, the property of Sir R. Palk, where the quay is situated, lies to the east of the rivulet separating the possessions of that gentleman from those of Mr. Cary. The aspect of the place was far more romantic than can be now imagined. The deep and narrow gorge between the Braddons and the Waldon Hill was a sylvan scene; on the one side were the craggy cliffs, while on the other the unviolated woods were in the wild and beautiful state in which they had been fashioned by nature.*" This description is illustrated by Plate II., which is a view of Stentiford and Waldon Hills as seen from Castle Hill, with the intervening Fleet valley, and has been taken from a drawing made in 1824 now in the possession of Mr. B. G. King of this town.

* It must be remembered that a rocky promontory then projected from the eastern side of Waldon Hill, and that this was afterwards cut away and levelled to make the platform on which Cary Parade and Abbey Place now stand (see White's History, p. 116).

Plate II. View of the Fleet Valley between Stentiford and Waldon Hills, from Castle Hill, in 1824.

The rows of houses which now fill the valley of the Fleet, and the bare rocky faces of the old quarries behind them, make it impossible to realize the original and natural aspect of this once beautiful ravine; but some idea of its contours can be obtained from certain points of view along the Warren Road which runs along the east side of Waldon Hill. Here, from an elevation of about 150 feet, one can look across the narrow valley to the slopes of the Braddons and Stentiford Hills which rise to more than 200 feet on the other side, and also seaward to the bay of the harbour into which the valley opens. A good view is also gained from Happaway or Stentiford Hill down the valley to its outlet between Braddons Hill and Waldon Hill.

Just as without such old views and descriptions it would be difficult to realize the primitive aspect of the Fleet valley, so also the volume of the stream which flowed down the valley must not be estimated by that of the insignificant rivulet that is allowed to remain as its modern representative. In prehistoric times, when the whole country was clothed with forest, the rainfall was probably much greater than it is now, and after heavy rain on the watershed ridge and on the Upton slopes, the brook must have become a rushing torrent. On this point indeed we are not left to conjecture, for up to the middle of last century the site of Union Street not unfrequently suffered from floods, and Mr. White (p. 114) records an occasion when "the stream, fed by heavy rains, swelled into a torrent and carried away the whole of the enterprise [a nurseryman's establishment]; broken sheds, trees, and stock were

swept bodily into the sea, and the unfortunate agriculturist abandoned the site in despair."

A few lines must be given to Ellacombe, which can hardly be called a valley, but is a broad combe or hollow, bounded on the north by Bronshill, on the east by Babbacombe Downs, and on the south by Warberry Hill. Even on the west it is shut in by the ridge which ends in Castle Hill, and the only outlet for the rainfall on the slopes of this combe was by the narrow gully or ravine which is now occupied by Market Street. This is so narrow that from most points of view Ellacombe valley seems to have no outlet.

The rocky sides of Market Street gully must have been very picturesque in their original condition. The limestone, however, has been so largely quarried on each side of the street that its natural features are now almost destroyed, and I dare say many of the modern inhabitants of Torquay fail to realize the natural origin of this passage and imagine it to be an artificial cutting.

On the south side of Warberry Hill another combe or short valley opens directly into the bay of the harbour; this is the Torwood valley, the head of which is just above Grist's Riding School and only half-a-mile from the sea. This was originally a wooded glen, but carried very little water except temporarily after heavy rain.

The eastern part of the Torquay promontory is drained by two short valleys which, though now separate, were originally one continuous waterway, and are still connected by a valley-like depression. These are the Bishopstowe and the Ilsham valleys. The first commences at Babbacombe and receives the natural

rain-drainage from Cary Park and Babbacombe Downs, as well as from the eastern slope of Warberry Hill; thence it passes south-eastward by Bishopstowe Lane, till it is breached by the landslips at the back of Ansteys Cove, into which the water now escapes. Ansteys Cove, however, is certainly not its natural outlet, but probably marks the spot where a tributary valley came in from the north-east and drained the land which must formerly have existed between Long Quarry Point and Black Head before the coast had been cut so far back by the sea.

The Ilsham valley may be said to begin in Wellswood at the spring from which the place doubtless takes its name, for "well" is the old English for a spring, and forms a part of many village names, such as Ogwell, Kerswell, and Edginswell; thus Wellswood was the wood in which the well or spring of the locality was situated. This source is about 200 feet above the sea, and as the distance along the valley way to the sea is only three-quarters of a mile, the descent is rapid, so rapid indeed that to anyone who has studied the physical features of valley-mouths it is apparent that this is a curtailed valley, and that its course was originally much longer and less steep. A view of this valley, where it passes between Lincombe and Kilmorie Hills, is given on Plate III.

The history of this little valley-system, its development, curtailment and isolation, will be more fully described in a future chapter, when the connection between it and the Bishopstowe valley will also be indicated.

From the above brief description of the valleys which

traverse the Torquay district it will be seen how many curious and interesting problems they suggest, and how many changes must have happened since these watercourses were first established on the surface of the land. In the sequel I propose to explain how it is that the valleys have been excavated so deeply, how such ravines as those of Combe Valley and Market Street were made, and how some valleys have been "beheaded," while others have been extended, and how all have been curtailed by the encroachments of the sea.

The explanation of the valleys will render that of the hills a very easy matter, for the latter are to a large extent merely the complement of the former, inasmuch as they are the surviving portions of the rock-masses out of which the valleys have been excavated.

CHAPTER III.

Contents.— TORQUAY ROCKS AND THE FORMATIONS THEY BELONG TO; ORIGINAL EXTENSION OF NEWER FORMATIONS OVER THE AREA; THE RECONSTRUCTION OF COVERS. VALLEY-MAKING; EROSION CONTROLLED BY SUBSIDENCE AND UPHEAVAL. TIME FOR EROSION AND DETRITION.

I SHALL trouble my readers as little as possible with the dry details and technical terms of Geological Science, because my object is to show that a very little knowledge of Geology will go a long way in explaining the origin of hills and valleys all over the world, as well as around Torquay in particular.

In this chapter, however, I must state some facts respecting the rocks which enter into the structure of the Torquay district for the benefit of those of my readers who have not acquired any previous knowledge of them. I shall rigidly exclude topics which are not germane to the subject, and shall not therefore describe the rocks or the manner of their formation in any detail, but will merely enumerate them, and briefly indicate the relations which they bear to one another.

Eight different sets of beds, or rock-groups, can be recognized near Torquay, but these represent only two of the great rock-systems which make up the European portion of the Earth's crust. Placed in their original

order of age and sequence, these eight groups are as follows: No. 1 being the oldest, and No. 8 the newest.

Systems.	Rock-groups.
Permian	8. Red conglomerate and breccia.
	7. Red clay (Watcombe clay).
Devonian	6. Red shale (a small thickness).
	5. Hard limestones of various colours.
	4. Black lava (Diabase).
	3. Red and grey slates (Eifelian slates).
	2. Red and grey gritstones (Warberry Grits).
	1. Hard slates and grits (Meadfoot Beds).

It will be seen that all the slates, grits, and limestones belong to the Devonian system. They underlie the whole of what may be called the Torquay promontory and form the varied cliff scenery all round this promontory from Torquay harbour to Hopes Nose, and thence northward to Babbacombe. On the other hand, all the red brick and pottery clays, and all the sandy conglomerates which form the cliffs above Oddicombe Beach and again between Petitor and Watcombe Bay, belong to the Permian System. The relative areas occupied by these two rock-systems are shown on the map (Fig. 1).

Further, it must be mentioned that the Permian period did not directly succeed the Devonian, for the whole of the Carboniferous period intervened. There is therefore a break in the local succession of strata, represented elsewhere by the Carboniferous Limestone Series and the coal measures. At the close of Carboniferous time the Devonian rocks were consolidated, flexured and dislocated; finally, they were lifted into

land, the elevation being accompanied by the formation of volcanoes from which much lava was poured out. Blocks of this lava, as well as pieces of the Devonian limestones, are common in the Permian conglomerates.

When these movements and disturbances had ceased a large inland lake seems to have been formed, in which the Permian beds were accumulated and spread out over an irregular surface of the Devonian rocks. Thus it came to pass that the former rested in some places on the Devonian limestones, in others on the slates, or again on the grits.

But although the rocks above enumerated and classified are all that actually occur in our particular district, a little more geological knowledge is required before the origin of our valleys can be properly understood. Thus, though the Permian conglomerate is the newest rock which is to be found anywhere round Torquay, or near the shores of Torbay, it is not the newest stratum which has ever been deposited over this district.

On the Haldon Hills there are remnants of two newer formations overlying the Permian conglomerate; the older of these consists of soft sands belonging to the Cretaceous System, which are about 100 feet thick; the newer (overlying the sands) is a pebbly gravel belonging to the Eocene Series. This gravel is believed to be the same as that which underlies the sands and clays of the Bovey Plain, and consequently it is inferred that the sands and clays of the Bovey Beds were originally continued up to and over the summits of the Haldon Hills.

That both the Cretaceous sands and the Eocene beds

originally extended southward over all the country lying to the east of Dartmoor hardly admits of doubt, and in order to picture the surface of the land on which our modern valleys were originated, we must imagine all these different formations to be replaced in their natural order above the Devonian rocks. This process of restoration may be termed the "reconstruction of the original covers," each separate group or formation above the lowest being regarded as a separate cover. In this case we have three distinct covers to consider, namely, (1) the Permian, (2) the Cretaceous, and (3) the Eocene. Now, if no break or disturbance took place between the deposition of these covers, the work of restoration would be easy, but we know that movements and changes took place in the intervals between each of these periods.

Thus the interval between the Permian conglomerates and the Cretaceous sands of Haldon represents a very long period of time, during which all the Liassic and Oolitic beds were formed. Some of them probably extended over this part of Devon, but if so they were destroyed before the formation of the Cretaceous sands. The movements of subsidence and upheaval which occurred during this time caused some of the displacements or "faults" which are now visible, cracks being formed, along which vertical movement took place, so that some masses of the Permian beds were let down between tracts of Devonian rock. In this way the mass of conglomerate which forms the back of Oddicombe Beach is let down about 300 feet between tracts of Devonian limestone and slate. By these displacements portions of the conglomerate have been

preserved, while the contiguous parts have been destroyed.

After remaining as land for a time, the greater part of Devon was carried beneath the sea by the great Cretaceous subsidence, and a gently sloping surface was planed across the edges of the Triassic, Permian, Carboniferous and Devonian rocks. Over the Torquay area, as over that of the Haldon Hills, a considerable thickness of Permian still remained, and on it were laid down the Cretaceous sands (Greensand), succeeded by many hundred feet of slowly deposited calcareous ooze, which consolidated into what we know as chalk.

Once more the British region was lifted above the sea, and again subjected to the detritive action of rain and rivers, so that in the interval between the close of the Cretaceous period, and the time when the Bovey Eocene was formed, much material was removed. In our district, not only all the Chalk, but in places all the Greensand and much of the remaining Permian conglomerate was broken up and destroyed, so that the Eocene beds came to lie partly on the Greensand, partly on the Permian, and in places even on the Carboniferous and Devonian rocks.

The lowest Eocene beds are the gravels of Aller Vale and other places near Newton, and upon these were deposited the sands and clays of Heathfield and Bovey. Remnants of these beds can be traced between Coffinswell and Kingskerswell to Fluder on the Barton Hall ridge, and is fairly certain that they originally extended southward and eastward over the whole of the Torquay district, resting in some places on the Permian, and in others directly on the Devonian rocks.

Finally, during the Miocene period, great lateral pressures were developed in this region of the earth's crust, so that it was compressed and bent into a series of flexures. One of these flexures appears to traverse Devonshire from N. W. to S. E., and the Eocene beds between Bovey and Newton Abbot are thereby bent into a deep trough, the floor of which is more than 500 feet below the surface of the ground at Heathfield. The flexure seems to have died out to the east of Torquay, causing only a southerly tilt or inclination of the surface over the Torquay area.

The above statement of facts has been made as brief as possible, but it was necessary to show that other and much softer kinds of rock, besides those now visible around Torquay, come into the problem. It is absolutely necessary to realize that when the existing valley-system was initiated no Devonian rocks were exposed in the Torquay district, but that these rocks were partly covered and concealed by the Permian conglomerate, and completedly buried beneath the Eocene deposits to a depth of several hundred feet.

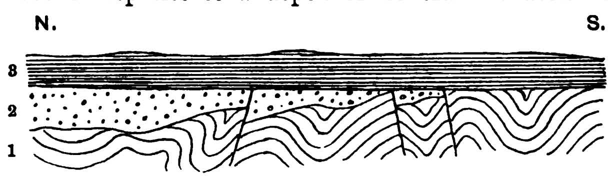


FIG. 2. DIAGRAM TO SHOW THE ORIGINAL SUPERPOSITION OF FORMATIONS IN THE TORQUAY AREA.
1, *Devonian rocks.* 2, *Permian.* 3, *Eocene beds.*

Consequently the surface on which the modern lines of drainage were first marked out was a surface of Eocene clay or sand, having a gentle slope from north to south.

The diagram (Fig. 2) will serve to indicate the general composition and structure of the land-mass, out of which the existing physical features have been carved.

We are not here concerned with the contours of this Eocene surface in other parts of the county outside that which I have defined as the Torquay district, but it may be well to remark that it was an extension of this surface on which the drainage-systems of the Dart and the Teign were gradually developed, and on which the lines of watershed between them and the Torbay area were eventually determined.

Besides the small amount of constructional knowledge which I have endeavoured to convey in the preceding paragraphs, it is necessary that there should be no mistake about the agency which has played the chief part in the excavation of the valleys. It has been stated in Chapter I. that this agency was that of running water, but it was also mentioned that the belief in the efficacy of brooks and rivers to make valleys is of comparatively modern establishment, and it is possible that some of my readers may not be inclined to accept this belief without further explanation.

It is true that 50 or 60 years ago the prevalent opinion with regard to the origin of valleys in general was that they owed their formation to the action of waves and marine currents as the land emerged from the sea,* but the cogent arguments of G. Greenwood, J. B. Jukes and A. C. Ramsay between the years 1857 and 1864 convinced the geological world that the real

*See for example A. C. Ramsay "On the Denudation of South Wales," in Mem. Geol. Survey, Vol. 1., p. 332 (1846).

agents were rain and rivers, and that the erosive action of the sea tended to produce a nearly level plain with only such slight inequalities as would guide running water in certain directions and so initiate the development of different basins of drainage.

Everyone knows that when rain falls on a newly-formed and fairly even slope of earth or clay it gathers into little rills, which quickly find out the slight inequalities of the surface, and make their way along these to the lowest level of the ground. If the surface is large enough, the development of miniature valleys and drainage basins may be actually watched, for the little rills which start at various points converge toward the slight depressions, where they unite to form a large rill, and if the slope is long enough, some of these again unite to form a larger stream. Each rill erodes or eats out a channel, and carries away the particles which it removes, and these channels are gradually sunk deeper and deeper into the mass of material.

The process can also be studied on some sea-shores, where the tide goes out a long way and leaves a broad expanse of sand or mud. The surface of this expanse is never completely flat, but slightly undulating, with a general slope from high to low water-mark. The water, which drains out of the sandy or pebbly beach near high water-mark, courses over the undulating plain, and behaves in the same way as rain falling on a similar surface. It gathers into rills which carry away particles of sand or mud, eroding and excavating channels, which sink deeper and deeper into the surface as the sea sinks to a lower and lower level.

It is obvious, however, that none of these channels can be cut down to a lower level than that of the sea at dead low-water.

So also on land, no river can cut its channel lower than the mean sea-level, and, if the relative levels of land and sea were never altered, Nature would long ago have struck a balance between the processes of erosion and deposition. The earth, however, has not attained a condition of rigid stability; its internal equilibrium is frequently disturbed in consequence of the continued escape of heat, so that portions of the earth's crust are moved, some parts sinking, others rising, according to the varying pressures induced. This process has been going on through all periods of geological time, so that every country has frequently sunk beneath the sea, and has as frequently been lifted again into dry land.

These alterations of level really control the power of rivers to deepen their channels and their valleys. Thus, if a system of valleys has been formed on the surface of a country while it remained for ages at a certain level above the sea, vertical movement in either direction will alter the erosive power of the rivers. If the land subsides, the seaward ends of the valleys pass below the sea level; the tide runs farther up the valleys, the velocity of the rivers is checked, and they begin to fill up their valleys with alluvial deposits instead of cutting them deeper. If, however, a movement of upheaval ensues, the sea retires, the rivers regain their former velocity and cut fresh channels through the alluvial levels, and if the whole area is raised to a higher level than it was to begin with, the

streams eat into the bottoms of their ancient beds and the whole valley-system becomes more deeply incised into the land.

Subsidence and upheaval also act in another way to modify or increase the rapidity of erosion and detrition; for the quantity of rain that falls upon any tract of land is generally proportional to its height above the sea. The uplift of a country will therefore increase the rainfall on its higher parts, the heavier and more frequent rains will carry more soil and detritus into the rivers, and at the same time will increase their volume, so that material is everywhere more rapidly removed from the surface of the land. On the other hand, subsidence reduces the rainfall, and decreases the volume of the rivers, consequently it lowers the rate of general detrition, and lessens the power of the streams to erode their channels.

I have been careful thus to insist on the manner in which valley-making is influenced by earth-movements, because it is a complete answer to those sceptics who have refused to accept the modern belief in the action of rivers. They point out with perfect truth that some rivers are not now deepening their valleys, but this is because these valleys were finally deepened and shaped during a period when the land stood at a higher level, and when the rainfall was greater than it is at present. The subsequent subsidence, and the decrease of rainfall has practically stopped valley-erosion in this region; but if the whole area were raised again by even so much as 100 feet, every stream would once more begin to deepen its channel.

Plate III. The Ilsham Valley looking Southward.

CHAPTER IV.

THE PROCESS OF VALLEY-MAKING.

Contents.—DEVON IN THE MIOCENE PERIOD. REMOVAL OF EOCENE COVER. EROSION OF PERMIAN BEDS. TRANSFERENCE OF VALLEYS TO THE DEVONIAN ROCKS. DEVELOPMENT OF HILLS.

It was stated in the last chapter that the original courses of our Torquay valleys must have been established on a surface of Eocene deposits, probably sands and clays, high above the present surface of the ground. In all probability this surface lay from 400 to 500 feet above the summits of the existing hills, except, perhaps, those of the watershed ridges.

We can now indicate the manner in which these successive covers of Permian and Eocene strata have been removed from those tracts where Devonian rocks are now exposed; and can also show how the waterways, which were established on one surface, have been gradually transferred to a lower and very different surface.

We know very little about the geological history of Devonshire during the periods which followed the Eocene, *i.e.*, the Oligocene, Miocene, and Pliocene; but it is fairly certain that it remained as dry land throughout these periods, and that the work of valley erosion was carried on almost continuously, though it

may have been retarded for a time in the Pliocene period by the subsidence which allowed of the formation of the St. Erth beds in Cornwall. It must, however, have been renewed by the subsequent elevation of the land, and was only brought to a close by the subsidence which ushered in the epoch in which we now live.

It will be seen therefore that the lapse of time, since the Eocene deposits were first raised above the sea, has been amply sufficient for the accomplishment of an enormous amount of denudation and erosion; in other words, for the removal of a vast quantity of rock-material from the surface of the land, and for the excavation of all our combes, valleys, and ravines.

In the first place we must imagine Devonshire as part of a much larger region than the south-west corner of England. England, indeed, did not exist as a separate country in Oligocene and Miocene times, but formed part of the continent of Europe, for these periods were especially an era of uplift and of continent building throughout the northern half of Europe. In Miocene time the shore of the Atlantic Ocean probably lay from 200 to 250 miles west of the present coast of Devon, continuous land not only uniting Devon with Ireland, but both with the north of France.

All our southern rivers were then but tributaries of a greater river, which occupied what is now the floor of the English Channel, and flowed into the Atlantic some 100 miles to the west of Brest. We have, therefore, to picture our little Torbay district as part of the interior of a north European continent, and in all probability as part of a high plateau dominated only by the still higher moorlands of Dartmoor.

It is impossible to restore the physical geography of this period with any degree of accuracy, but it is probable that the elevation of the land was such that the sea-level lay somewhere between the present submarine contours of 60 or 70 fathoms, and if this were so, the land must have stood about 400 feet higher than it does now. Allowing, moreover, for the amount of material subsequently removed, its actual surface may have been 400 feet above the higher parts of the present surface, so that tracts around Torbay, which are now only about 300 feet above the sea, were then parts of a plateau which may have been from 1,000 to 1,100 feet above the same level, sloping up westward to the still higher plateau of Dartmoor, the whole of which must have stood some 500 feet higher above sea-level than it does now.

All these figures are merely illustrative, and more or less probable guesses, but they are low estimates, and the actual heights may have been much greater. Moreover, we may use the figures for further illustration of the forces which were then at work. The present average rainfall near Torquay is stated to be 35 inches per annum, but on the eastern border of Dartmoor, where the land rises to between 800 and 1,000 feet above the sea, the annual rainfall is from 50 to 60 inches, and assuming that the rainfall over the whole of Dartmoor was greater in Miocene time than it is now, because of its greater elevation above the sea, the rainfall over Torquay and East Devon generally is likely to have been about that of the present 1,000 to 1,200 feet zone. It is at any rate very likely to have been more than 50 inches per annum, and, as above

stated, a greater rainfall means a more rapid removal of material from the surface of the country.

Let us imagine the action of frequent rains, and of numerous rapid streams acting on the surface of land which consisted of soft clay and sand (see Fig. 2). As the continent gradually rose higher and higher during the Miocene period, the streams must have cut deep channels in the Eocene sands, and these channels would be gradually widened into valleys by the action of rain. At first the spaces between the valleys would be merely portions of the plateau, and consequently more or less flat, but as the valleys were deepened, the intervening spaces would be sculptured into a series of ridges, divided by a network of tributary valleys and watercourses.

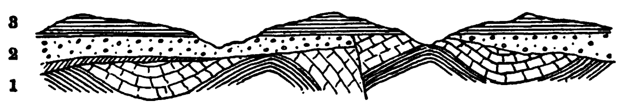


FIG 3. A STAGE IN THE PROCESS OF VALLEY-MAKING.
1, *Devonian rocks.* 2, *Permian beds.* 3, *Eocene beds.*

The soft clays, sands and gravels would yield rapidly to the action of all the atmospheric and aqueous agencies mentioned on p. 29, and by the close of the Miocene period, the thickness of the Eocene deposits must have been greatly reduced over the Torquay area. Fig. 3 is an endeavour to represent this stage in the sculpturing of the country; many of the valleys would then have been cut down through the whole thickness of the Eocene cover, and the streams would be attacking the underlying Permian beds or the Devonian rocks as

the case might be. As time went on, the patches of Eocene which still remained on the ridges between the valleys would be gradually wasted by the action of rain, sun and wind, till the older rocks were completely denuded of their original cover, not only in the valleys but on the ridges.

Whether this incision of the valleys through the Eocene cover into the underlying surface of Permian and Devonian was reached in the Miocene period, or in early Pliocene time, does not matter, nor are we ever likely to know; the important point is that there must have been such a stage in the detrition and dissection of the plateau, a stage when the valleys which had been established on the surface of one set of rocks were transferred to the surface of another set, and a new series of physical features began to be developed.

Here it is important to bear in mind what was stated on p. 28, that although the whole surface of Devonian rocks was undoubtedly once covered by the Permian deposits, just as it now is so covered in the area which lies between our northern watershed and the estuary of the Teign; yet there is good reason to believe that the Permian was removed from a large part of the Torquay area before the deposition of the Eocene beds. The reasons for this belief need not be discussed here; they are connected with the formation of the plateau-area on which St. Marychurch and Babbacombe are situated, and the relation of this plateau to the other physical features of the country will be explained in subsequent chapters.

It will suffice for the present to say that we may assume the surface of the rocks underlying the Eocene

cover to have been for the most part a nearly level surface, planed across these older rocks; so that in some cases the valley-courses were transferred for their whole length to an intervening mass of Permian strata, while in other cases they were impressed upon a complex surface composed of some or all of the various rocks enumerated on p. 24, clays, conglomerates, limestones, slates, and grits.

Of the area within the boundaries of the Torquay district only one part retained much of its original Permian cover under the Eocene deposits. This was the western portion of the area which is now traversed by the Torre valley (see map, Fig. 1). This tract lies in a trough-like depression which may be partly a hollow or valley of Permian age, but is probably in part, a flexure produced by subsequent earth-movements. East of this trough the Devonian rocks emerge from beneath the Permian beds and rise into the hills and plateaus of the Torquay promontory. It is probable, therefore, that the surface-areas now occupied by the Permian and Devonian series respectively, as shown on the map (Fig. 1), correspond very nearly in their relative extent with the areas occupied by them in the old plateau-surface underlying the Eocene cover. In order therefore to picture to ourselves the aspect of this sub-Eocene surface we have only to imagine the various areas of slate, limestone, etc., filled up again to the level of the Babbacombe and Marychurch plateau, *i.e.*, to about 300 feet above the present level of the sea.

Let us next consider what would happen after the transference of a valley to the surface of the older rocks. So far as its further incision or excavation was

concerned, the process of valley-making would be continued along the same course, without reference to the relative hardness of the rock-masses composing the old surface, except that the rate of erosion and valley-deepening would be determined by the position of the harder rocks.

Thus imagine a valley excavated through the Eocene cover, and suppose that in one part of its course the Devonian rock underlying this cover is shale, while a little lower down it is limestone; the shale is of course much more easily broken up and removable by the river-current than the limestone, but the river-channel cannot be cut down to a lower level in the shale than it is in the limestone; neither can the stream be turned aside by harder rock, because it is kept in its original course by the slopes of the valley above. In other words the rate at which the river can deepen its channel through the limestone is the measure of the rate at which it can work through the shale.

But although the course of the valley is not altered by such transference, its width and general aspect is often much changed, for where the shale underlies the Eocene cover the banks crumble down more easily so that the valley is widened; moreover, some of the rain which falls on that cover would issue again in springs on each side of the valley, so that landslips would be caused, and wide gentle slopes of shale gradually formed. On the other hand, where the cover is underlain by limestone no such landslips can occur, for the rain will soak into the limestone; here too the stream has to concentrate all its force in deepening the channel, so that the valley becomes narrower, and that

part of it which is sunk into the limestone often becomes a ravine with steep or vertical sides.

Let us consider now what must happen with regard to the further development of physical features out of such an arrangement of rock-masses as that above imagined. The disintegration and wearing away of the Eocene cover would be incessantly continued so long as the stream in the valley had sufficient velocity to carry off the detritus that was washed into it; thus the area covered by the Eocene deposits would be gradually diminished, and *pari passu* the exposed surface of Devonian rock would be increased.

We have seen that almost from the first the differing hardness of shale and limestone exercised a modifying influence on the features of the valley-slopes, and as more and more of the two kinds of rock became exposed, the more marked would be the effect of this difference in their capacity of resisting detritive agencies. Limestone yields very slowly to such action, while shale is rapidly worn away by rain flowing over surfaces which have been loosened by alternations of summer heat and winter frost. It is true that limestone is liable to chemical solution and erosion by the water passing through it, but this action is chiefly subterranean, resulting in the widening of fissures and in the formation of caverns; the surface of the limestone is doubtless lowered by such solution, but very slowly.

Thus it comes to pass that the shale is worn down into comparatively low ground which slopes very gently toward and into the valley-way; while the limestone is left to stand out as a ridge or tract of relatively high

ground extending back from each side of the narrow ravine through which the brook passes. The final result is that the river or brook seems to have cut its way through a ridge or range of hills, when the real fact is that the ridge has been developed out of the rock-mass through which the brook had cut its way.

This development of hills and ridges out of the rocks, which were not exposed at the time when the valleys were first established, explains many of the physical problems which present themselves both in this and in other parts of England. It is in this way, for instance, that the long and deep gorge of the river Avon near Bristol has been formed; its excavation was commenced when the Carboniferous limestone and the whole Bristol coalfield were covered by the red sandstones and Liassic clays, of which tracts and patches still remain all round the Bristol area. The high ridges of Durdham Down and Leigh Down, south and south-west of Bristol, owe their present elevation or height above the rest of the country, not to actual elevation or uplift above the sea level, but to the fact of their consisting of hard limestone which has offered a greater resistance to the detritive action of rain than the red conglomerates and marls which lie on their flanks.

In the same way all the hills of the country around Dartmouth and Kingsbridge have been formed out of a surface which passed across their summits, and they owe their existence as hills to the removal of the material which originally filled up the intervening valleys.

Having now indicated the general principles which govern the process of valley-making, and having

described the conditions under which the valleys of East Devon have been developed, I think the reader will find no difficulty in comprehending the following chapters, in which the development of the valleys in our particular district is more fully explained.

CHAPTER V.

The History of the Torre Valley.

Contents.—Connection between Hatchcombe and Torre Valleys. Geological Structure of the ground. How the brook was diverted.

The Torre valley is familiar not only to all residents in Torquay, but to all those who travel by road or rail from Newton Abbot to the shores of Torbay; for its higher part forms a natural passage through the hilly ground which separates the Torbay area from the valley of the Teign.

Moreover, the Torre valley is one of the most peculiar features in the Torquay district, for while most valleys have a natural head or terminal combe situate on the slope of a watershed, this one has no such head, but opens out at its northern end into the valley of a little rivulet which is a tributary of the Aller brook.

The modern Torre valley may be described as consisting of two different portions; an upper narrow valley which carries little water, and a lower broad alluvial valley, which separates Torquay from Chelston, and terminates on Torre Abbey sands.

The upper valley commences near Lowe's Bridge where the road to Newton is carried over the railway, and where the surface level is about 165 feet above

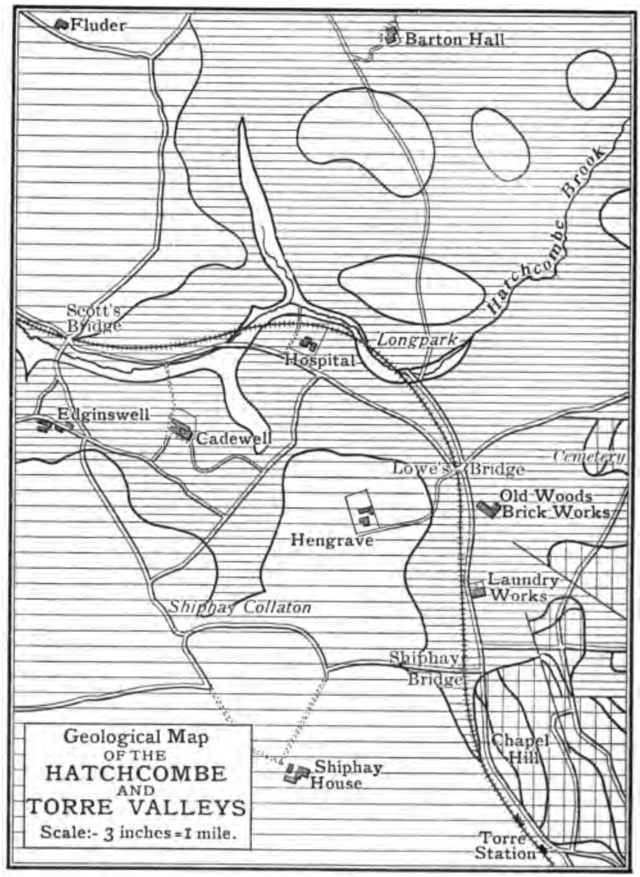


Fig. 4.

3, *Permian conglomerate.* 2, *Permian clays.*
1, *Devonian rocks.*

O. D. (see map, Fig. 4.) The only permanent flow of water which now comes into the valley near this point is a small rivulet which appears to have its origin in a spring issuing near the Barton road by the south end of the Cemetery wall; thence it flows round the Old Woods Brickworks, and is carried under the Newton road into a channel by the side of the railway. Its little valley or combe is joined by a depression carrying rain-drainage along the northern side of the Cemetery; but a glance at the map, or a view of the ground, will show anyone that these little combes are lateral tributaries, and do not form the natural head of the Torre valley.

The part of this valley which lies between Lowe's Bridge and Torre Station has been cut out of a plateau, the surface of which rises to over 200 feet above O. D. on each side of the valley, and near the Station the valley is about 100 feet deep. The valley-floor has, of course, been artificially deepened by the cutting for the railway, and before this was made the natural water-course was probably very little below the level of the road as far as Old Woods lane, where the road-level is 136 feet. By Shiphay Bridge another small feeder comes in, and a little south of this the railway passes on to the actual floor of the old valley for a short distance, leaving it again near the contour line of 100 feet.

The lower portion of the valley extends from Torre Station to the shore near Torre Abbey. This part has evidently been widened by the flow of water from numerous springs, and by the consequent recession of the spring-heads. Some of these springs on the western side of the valley are still visible, but those on

the eastern side have been diverted and drained off during the building of houses in Torre. Mill Lane, for instance, is the natural course of the water of St. Efrideswell, a spring which rose a little below All Saints Church.

We have seen that the upper end of the valley is merely a dry col or pass leading from one system of drainage to another; this pass certainly seems to indicate a former extension of the valley in that direction, but we must be careful how we theorise upon it. Some authors, trusting possibly more to a study of the map than to observation of the actual physical features, and perhaps also unconsciously biassed by the existing lines of road and rail, have imagined that the Torre valley was part of the ancient course of the Teign, or of a river which flowed out of a supposed Bovey lake in Oligocene time.

A careful consideration of the physical features of the country will, however, make it clear that the facts do not favour such a theory, and that they can be explained by a very much smaller demand on the imagination; merely, indeed, by the supposition of some comparatively small local changes.

In the first place it should be pointed out that if this valley were the work of the Teign, or of any river which carried a large body of water, the valley would have been much wider and deeper; more comparable in fact to that of the present estuary of the Teign between Newton and Teignmouth. On the contrary, our Torre valley is narrow and rises somewhat rapidly to a level of 160 feet above the sea; it has, in fact, all the appearance of a merely local line of drainage.

How is it then that the Torre valley is so abruptly truncated at its northern end? I think that anyone who stands on the bridge over the railway and looks over the country to the north and north-east can hardly fail to see where the head of the old valley originally lay. The peculiarities of the watershed between this part of the Torquay area and the valley of the Aller brook have been described in Chapter II.; and it was there pointed out that the connection between the western and northern lines of watershed was not where we should have expected to find it, namely, through Edginswell and along the Barton Hall ridge, but was deflected eastward across the Torre valley and round the head of the brook which rises in Hatchcombe, to the south-east of Barton Hall.

The valley of this brook thus forms an *enclave* which looks as if it had once been a part of the Torquay drainage-area, but had been in some manner cut out of it and transferred to another river-system (see map, Fig. 1). It looks, in fact, as if the Hatchcombe brook had originally been the head and source of the Torre valley, and as if the present abrupt termination of this valley near Lowe's Bridge was due to the diversion of the Hatchcombe brook into the valley of the Aller.

In the first place we must remember that the modern valleys were not originated and established on the surface of the Permian rocks, but on a surface of Eocene beds which extended over the whole district up to and beyond the northern watershed, and further, that this ancient plain had a general southerly inclination (see page 28). Hence it would have been natural for all the streams which originated to the south of the

watershed to have pursued roughly parallel courses. Consequently we should have expected the stream which originated the Hatchcombe valley to have followed a course similar to that of the Watcombe brook, and to have persisted in that course till it reached the area now occupied by Torbay. This course would have been down the Torre valley.

The explanation above suggested to account for the truncation of the Torre valley is therefore in accordance with what we might have anticipated from *à priori* theoretical considerations. Let us now see how far the facts support this view, and to understand these the reader must refer to the map (Fig. 4) on which the topography and geology of the district are delineated on the fairly large scale of three inches to a mile.

The Hatchcombe brook rises just beyond the eastern border of this map and runs south-westward to a point near Longpark, where it is only about 300 yards north of Lowe's Bridge; but instead of turning southward into the Torre valley it bends to the north-west, and after receiving a little feeder from the north pursues a westerly course by Edginswell to the Aller brook.

The level of the ground at the bend east of Longpark is about 150 feet O. D., and that of the ground by Lowe's Bridge is 165 feet. If, therefore, a dam was made across the Hatchcombe valley near Longpark to a height of about 16 feet, a small lake would be formed, the overflow of which would run down the Torre valley, *i.e.*, southward instead of westward.

Moreover, an examination of the levels along the courses of the Hatchcombe and Torre valleys shows that the one may well have been a continuation of the

other. The stream in the former valley rises at or a little below the contour of 300 feet, and it passes over the contour of 200 feet just half-a-mile N.N.E. of Lowe's Bridge, where the level is 165 feet.

There is, therefore, quite a sufficient fall from the present line of 200 feet to carry the stream through the gap into the Torre valley, the difference of level being 35 feet. But at the time when it may have taken this course the contour of 200 feet could not have been so far up the valley; in other words the point in the valley-way which now coincides with that contour-line would not have been cut down to so low a level. Since the brook near Longpark has cut its valley about 15 feet lower than the level of the Torre valley gap, let us take this as a rough measure of the extent to which all this northern part of the valley has been deepened since the supposed diversion of the stream. We may then assume that the point which is now 200 feet above the sea was then 215 feet; the difference between this and the level in the gap is 50 feet, and the distance is half-a-mile, so that we get an approximate idea of the incline of this destroyed part of the old valley-way.

Now the upper part of the Torre valley can hardly have been much altered since the diversion of the Hatchcombe brook, consequently its slope for half-a-mile or so should be approximately the same as that above indicated. The valley bottom has of course been graded for the railway, but exactly half-a-mile south of Lowe's Bridge, and a little to the north of Torre Goods Station the line seems to pass over the natural surface of the ground where it appears to be about 115 feet

above Ordnance datum. Hence, in the same distance, there is the same fall or incline (viz., 50 feet) as that which we calculated for the adjoining destroyed part of the old valley. This coincidence is at any rate a very remarkable fact.

Below Torre Station the slope of the valley is more rapid, because the lower parts of it have been cut down to a lower base-level, and because the original contours have been altered by the recession of the spring-heads within its limits.

It will be understood that if the Hatchcombe brook originally ran into the Torre valley, the watershed which then separated the streams running into Torbay from those running into the Teign must have lain to the westward somewhere near Edginswell. Even now the Barton Hall ridge sends a spur southward which brings the contour of 300 feet within 330 yards of the main road between Scotts Bridge and Kerswell Gardens, where the surface level is 130 feet, and the valley here is actually narrower than it is higher up. This therefore is the locality where the two lines of watershed would naturally be connected, and when this was the case the head waters of the Aller brook would lie entirely on the western side of this watershed, while all water issuing from or running off its eastern slope would drain into the Hatchcombe brook and pass down the Torre valley.

Let us next consider the geological structure of the district, and see whether it favours the above theory, and whether there are any local circumstances which may have led to the diversion of this brook into the valley of the Aller.

Reference to the one-inch maps of the Geological Survey shows that the valley of the Hatchcombe brook from its sources to and beyond Cadewell is cut through the basal clays of the Permian Series, and also that these clays bear several outlying patches of the overlying conglomerate or breccia, the whole having a marked dip or inclination to the south. It is also seen that the boundary of the large tract of conglomerate on the west slopes from over 300 feet near Fluder down to the level of alluvium opposite Edginswell, where the level of the surface is probably about 125 feet.

This southerly slope of the beds appears to be continued without interruption through the entrance to the Torre valley; the basal clays forming the floor of that valley to a point a little south of Shiphay Bridge, where they pass below the conglomerate beds. This continuous southerly slope is very suggestive, and goes far to confirm the view that the natural course of the Hatchcombe brook would be along the original surface of this slope, and consequently southward.

Further examination of the geological map shows that there must be a fault, or break in the continuity of the beds, along the valley opposite Edginswell, for the sandstone conglomerate (as above stated) there comes down to the level of the alluvium, which it borders for a considerable distance, though the level falls from 125 to less than 100 feet. On the south side of the valley there is a slope of red clay up through Edginswell to about the contour of 200 feet, so that the base of the conglomerate on the north side of the valley is from 80 to 100 feet lower than it is on the south side, and this in spite of the dip being to the

southward. The position of this fault is shown in the diagram section (Fig. 5).

FIG. 5. SECTION THROUGH EDGINSWELL.
1, *Red clays.* 2, *Conglomerate.*

Along this line of fault springs are thrown out, both near Coventry Farm and near Half Way houses, and the conditions are such that springs must always have been thrown out here as long as clay has been exposed along the south side of the fault. Indeed it is probable that springs would break out here even when the conglomerate bridged the valley and the surface was 100 feet higher than it is now. In the existence of these springs, and in the fact of their breaking out at such a low level compared with that of the springs which feed the Hatchcombe brook, I believe we have a clue to the rapid erosion and recession of the Edginswell part of the valley, and to the capture of this brook.

In order to understand how the change was accomplished, we must restore in imagination the bridge of Permian conglomerate across the valley north of Edginswell, which supposed to have formed part of the main watershed, and we must assume that the head waters of the Aller brook were then the springs near South Whilborough, and those issuing from the western part of the fault above mentioned. At the same time, of course, the Hatchcombe brook received

additional water from springs east of Edginswell before it passed into the Torre valley.

Such conditions may have prevailed for a long time, perhaps during the whole of Miocene and Pliocene time, for I do not think the diversion of this brook was effected before Pleistocene time, because the difference of level between the upper end of the Torre valley and the present valley-way at Longpark is so small, whence it may be inferred that there has not been time for any great amount of subsequent erosion.

The essential fact in the conditions above indicated is that the sources of the Hatchcombe brook and its channel near Longpark lay at a comparatively high level, and could not be lowered as the issuing waters deepened their channels, because the level of these springs is determined by the plane of the upper surface of the Permian clays. On the other hand, the eastern sources of the Aller were springs issuing from a fault, the plain of which probably has a steep hade (or inclination) to the north, the downthrow being on that side. Here therefore springs would continue to gush out, however much the general surface of the valley and of the country was lowered, because the valley of the Aller from this point Kingskerswell is cut entirely through the conglomerate, and the surface of the underlying clay is nowhere exposed. The lower beds of the conglomerate have consequently always been saturated with water, and all the spring-heads in these beds have been continuously active, so that the valley of the Aller has been excavated to a lower base level than that of the Hatchcombe brook has been or could have been.

Now active spring-heads issuing from a water-soaked stratum are always receding, partly because the water loosens the soil and rock around the spring, and partly because rain is always washing down soil from the head of the combe in which the spring lies. Thus the springs north of Edginswell would recede eastward so long as any conglomerate remained on the watershed, and before this was all removed they would have sapped the sources of the springs on the eastern slope. The watershed would thus be trenched by a valley which was being deepened to a lower base-level than that draining the country on its eastern side, and the head of this combe would consequently recede further and further into the eastern area, encroaching more and more on the tributary drainage of that area.

In this manner the water from springs near Shiphay and Cadewell House would be captured and diverted into the Edginswell branch of the Aller brook. Next the water coming in from the north side (opposite the site of the Sanatorium) would be similarly captured, and this would leave only a short length of dry valley-way between the valley of the Aller and that of the Hatchcombe brook. This is represented in the present valley by the reach near Longpark, the general direction of which is from N.W. to S.E., and I regard it as having originally been occupied by the little northern tributary on its way to join the Hatchcombe brook. At this stage in its history, when left dry, its slope would be a very gentle one from N.W. to S.E., but as the western stream was still being slowly deepened below the level of the eastern, the western end of this dry

valley would be lowered by the wash of rain, until a very few feet of vertical height separated the waters flowing south from those flowing west.

Finally, and probably at a time of heavy rainfall, when the Hatchcombe brook was in flood, a portion of the water ponded back by the narrowness of the Torre valley may have made its way through the connecting valley into the western stream, and once such a communication was established, the channel would soon be deepened to a lower level than that of the Torre valley at Lowe's Bridge.

This I believe to have been the history of these two valleys, and the explanation of the headless valley which is such a curious and evidently such an ancient feature in the geography of the Torquay district. The principle which underlies this explanation is by no means new; on the contrary, the capture of one stream by another, which is cutting its channel down to a lower base level, is a process which is believed to have taken place in many parts both of this and of other countries. It is only its application to the case of the Torre valley that is new.

It has been stated that the features of the lower part of the Torre valley, south of Torre Station, have been modified in more recent times since the beheadment of the upper valley. In the first place we find that the lower and upper portions of the valley are linked by a comparatively steep incline; for the 100 feet contour line curves round by the Goods Station, and that of 50 feet crosses Avenue Road where the road to Pilmuir leaves it. These two points are only a third of a mile apart, so that the slope between them is one of 150

feet per mile as compared with one of 100 feet per mile in the more northern part of the valley.

From the point on the Avenue Road above mentioned to the outlet of the stream in Torbay is a distance of two-thirds of a mile, and the level of the ground in Torre Abbey meadows is 12 feet above O. datum. Hence the fall between these points is only 38 feet or 50 per mile. This, however, is along the surface of the modern alluvium and peat, and not along the actual valley-floor. The depth of this floor below the present surface near the outlet was not known until last year, when, by permission of Col. Cary, borings were made in the lowest meadow to test it. These proved the solid floor to be about 17 feet below the surface, and consequently to be 5 feet below O. datum.

If, therefore, we assume the buried valley-floor to be a continuation of the upper part of the valley, the total fall from Torre Station to this level below the outlet should correspond very nearly with that of the upper valley. The distance is a mile, and the total fall is about 95 feet, which certainly compares very closely with the incline of 100 feet per mile in the higher part of the valley. The further course of the ancient Torre valley lies below Torre Abbey Sands and outside Torquay Harbour where it was joined by the valley of the Fleet brook.

CHAPTER VI.

The Upton and Fleet Valley.

Contents. — The sources round Barton and Watcombe. Why the valley runs by Lummaton Place instead of by Combe Pafford. The Combe Valley ravine. Upton Vale. The Fleet Street ravine. Depth of the Fleet valley.

The general course of this valley has been indicated in Chapter II., and can be followed on the general district map (Fig. 1). The valley is remarkable for the variety of aspect which it exhibits in different portions of its course, in some parts appearing as an open vale and in others contracting to a narrow rock-bound ravine. This variation is entirely due to the varying geological structure of the ground which it traverses, and it thus affords some excellent illustrations of the general principles stated in Chapter III. Moreover, the scenery to be found along parts of its courses entitles it to be regarded as the most picturesque of all our Torquay valleys.

The valley has of course been gradually excavated to its present depth by the erosive action of the brook which runs along it, or, more correctly speaking, by the precursor of the present brook, which, during some periods of its existence, must have been a much larger,

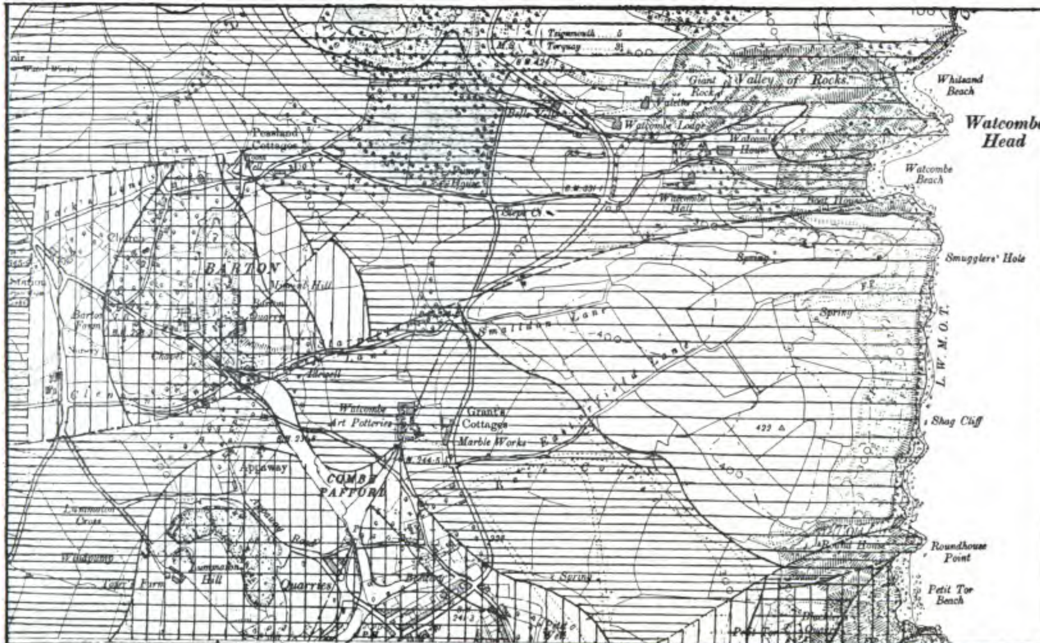


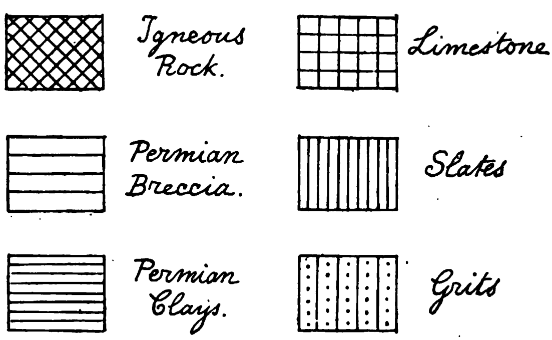
Fig 6. Geological Map of Watcombe and Barton. Scale 4 inches to a mile.

Based on the Ordnance Survey Map by permission of the Controller of H.M. Stationery Office.

and consequently more powerful body of water than its puny modern representative.

The sources of this stream are two small rivulets which start on the slopes of Permian clay below the Watcombe Park ridge. The western source is for the greater part of its length only a watercourse after heavy or long-continued rain; in the summer it is generally dry, but nevertheless there is a well-marked valley-way through the the limestone tract on which the hamlet of Barton is situated (see map, Fig 6).

The different kinds of rocks which enter into the structure of this area are represented on the map by different line-patterns, which will be understood by reference to the Index here given, and the same patterns are used in all the succeeding maps.



Much of the rain which falls on the Barton limestone and on the ground to the north of it is absorbed by the limestone-rock, and after pursuing an underground course is thrown out again in springs on the

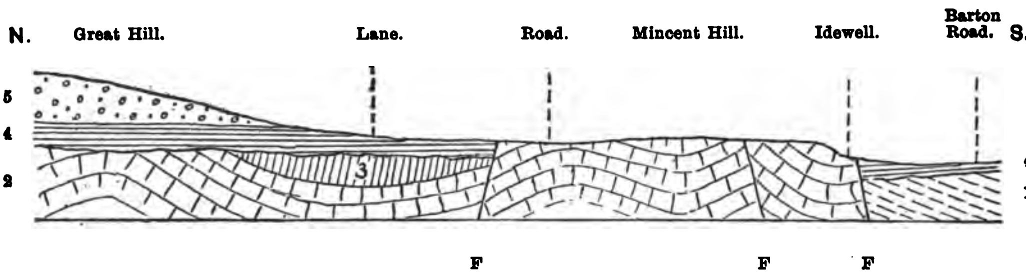


Fig. 7. Section from Great Hill through Mincent Hill.

Horizontal Scale 6 inches to a mile, Vertical Scale 800 feet to an inch.

5, *Permian conglomerate.*
4, *Permian clay.*
3, *Upper Devonian shales.*
2, *Devonian limestones.*
1, *Middle Devonian slates.*
FF, *Faults.*

southern border of the tract. The issue of the water in this manner is due to the existence of the fault or line of fracture which is shown on the map (Fig. 6) and in the accompanying section (Fig. 7). By this fault the Permian clay is brought down against the southern face of the limestone, and the water in the latter is ponded back so that the whole limestone-mass becomes a sort of reservoir from which the water escapes over the lip of the fault, at the points of easiest outflow.

The eastern rivulet has its chief source at Roomwell (Moor Lane) whence it flows through meadows to the Watcombe Terra-cotta works, and then under the Barton road to join the other brook. Except for the last few hundred yards its course is entirely over the Permian clay, but the volume of water is small, and in summer it is often dried up. In former days, however, when the rainfall was greater, and the slope of the watershed was thickly wooded, this rivulet was doubtless a permanent watercourse.

Moreover, it is highly probable that another small tributary brook came in from the well-known Valley of Rocks at Watcombe, and that this curious valley originally sloped from east to west, its present reverse slope and ruinous condition being due to the sapping and destruction of its upper end by the inroads of the sea. The chief reason for this supposition is that the valley narrows eastward and bifurcates in a manner which strongly suggests that two small watercourses here came down from higher ground to the eastward.

The probability of this is confirmed by the geological structure of the locality. The floor of the valley is formed of the Permian clay, while its northern wall

consists of the overlying Permian conglomerate, the general dip or inclination of which is a little south of east, so that its base slopes eastward through a height of 300 feet in the space of half-a-mile. The southern side coincides with a line of fault or displacement which brings in another mass of conglomerate dipping to the north-east. It will be seen from the map (Fig. 6) that this fault is a continuation of that which forms the southern boundary of Mincent Hill, and that if the dip on the north side of the valley were continued a little further to the eastward, when there was more land in that direction, the two tracts of conglomerate would be brought into apposition. They would then naturally form a continuous tract of high ground adjacent to, if not actually part of the main watershed of the area. My belief is that this was the case, and that the Watcombe valley was formed by watercourses draining westward off a tract of high ground which has been entirely destroyed by the sea.

Below the point where the Barton and Watcombe tributaries meet, the Fleet brook enters a gap between the limestone hills of Lummaton on the one side, and Park Hill (Marychurch) on the other. The summit of Lummaton Hill is about 340 feet above the sea, and that of Park Hill is about 270 feet, while the bottom of the intervening valley is only 200 feet above sea level, and so far as can be ascertained, the limestones are continuous beneath it. How then has the stream been able to cut its way through such an opposing mass of limestone.

If the reader has fully understood the explanations given in Chapter III. and IV. he will find no difficulty

in perceiving the answer to this question; that in the first instance when the course of the stream was determined, the limestone hills were not in existence; that the watercourse was established on a surface of Eocene deposits which passed at a high level over the summits of the existing hills.

It is not difficult either to see how the direction of the brook was determined, and how it was able to maintain this course. The rain, running off the water-shed ridge, which, of course, was then much higher than it is now, would gather into a watercourse which took a southerly direction over the Eocene deposits, taking a line of least resistance between such slight local irregularities as then existed.

The valley thus commenced would be gradually deepened till the stream had cut through the Eocene into the underlying Permian and Devonian rocks, the surface of which was a nearly level one planed across all the older irregularities, as represented in the diagrams (Figs. 2 and 3). In this way the valley was transferred to the older rocks, the stream continuing to deepen it while the valley-sides were modified by the action of rain operating on rocks of such unequal hardness as limestone, slate, and clay.

As time went on, and as the Eocene deposits were gradually worn away and removed from the surface of the older rocks, the other irregularities of the present surface began to be developed. Of the three materials above mentioned, the softest and most easily removable by rain is the Permian clay; consequently those portions of the exposed surface which consisted of these clays were wasted and lowered more rapidly than

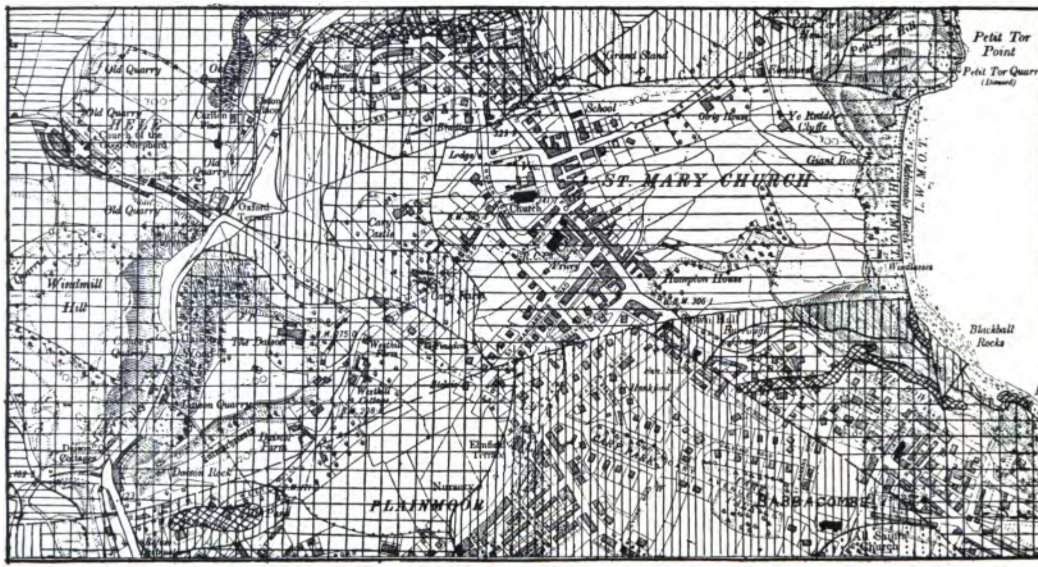


Fig. 8. Geological Map of the country round Marychurch and Babbacombe.

Scale 4 inches to one mile.

Based on the Ordnance Survey Map by permission of the Controller of H.M. Stationery Office.

the parts which consisted of conglomerate or limestone. Thus it came about that the latter were left to form hills and ridges, while the clay-tracts between them form lower ground, even where they are not occupied by watercourses.

It is in this way that the curious depression which extends from Combe Pafford to the Race Course by Petitor Road has been developed. No such depression could have existed when the natural system of drainage was first established, for if such a tract of low ground had been in existence when the Lummaton and Park Hill limestones formed one continuous mass, the Watcombe brook would certainly have run along it and would have entered the sea at Oddicombe Beach. The fact that it does not do so is proof that this depression is of much later date than the origination of the Barton and Watcombe valleys.

Returning to the valley of the united Barton and Watcombe brooks it will be understood that when the stream began to trench the limestone it did so on its summit level, and did not find its way through any natural crack or rift on the site of the present valley west of Marychurch. It should be noticed, however, that in this section of the valley the opposing slopes present very different features; the western side being steep, rocky, and in places almost precipitous, while on the eastern side there are gentle irregular slopes as far south as Blacks Hill. This difference is a result of differing geological structure (see map, Fig. 8), for the western side consists entirely of limestone, and is a continuation of Lummaton Hill, while on the eastern side that rock is cut out by a fault which brings up a

tract of slate or shale, which has mouldered down into much softer outlines.

South of the cross-roads at the foot of Blacks Hill another change occurs, and the valley is continued as a narrow and picturesque ravine, known as Combe valley, but often locally called "the Rocky Valley." This ravine was of course initiated as a continuation of the watercourse above the surface-level of the plateaus on each side, and only became a ravine as the stream gradually cut its way deeper and deeper into the limestone. Its depth now is about 170 feet below the intersected plateau, the ground on each side rising to over 300 feet and the valley-floor being only about 130 feet above sea level. It is so narrow, that for a part of the way, there is only just width enough along the bottom for the road and the little watercourse beside it.

Plate IV. is a view of this Combe valley looking southward from the slope at its northern end, and is taken from a photograph by my friend Mr. W. Hill. It shows the strip of alluvium which here forms the valley-floor, but which narrows out southward between the opposing limestone slopes. The curious rock in the distance is a projecting "tor" of hard limestone known as "Daison Rock." Another view of this valley, taken from a point further north, and showing the whole vista of it between Yaddon and Daison Hills will be found in Plate VII.

The total length of this narrow gorge is one-third of a mile, and a curious point about it is that it narrows southwards, a peculiarity which I am at present unable to explain. In its original state, with its steep slopes partly covered by wood, and partly of scrub-covered

Plate IV. The Combe Valley between Yaddon and Daison Hills, looking South.

rock, it must have been very picturesque, and though its beauty is now greatly marred by the quarries which have been excavated out of its sides, it still remains one of the finest bits of valley scenery to be found near Torquay.

The place is familiar to all residents in Torquay, but I wonder how many of those who have so frequently passed through it, whether on foot or in carriages, have given a thought to the manner of its formation, and how many have dismissed the question by referring it to some "convulsion of nature," little imagining that the tiny streamlet by the side of the road represents the mechanical power which has actually carved the valley out of the solid rock, though the present rivulet is certainly but an attenuated descendant of a once more copious stream.

The sudden termination of the ravine-like character of the valley at Upton is due to the effect of several lines of fracture which here cross the valley, and by the last of which a tract of slate is brought up into the valley-floor. Thence the valley passes through small outcrops of shale, grit, and limestone, till it reaches a place called Adwell, below Sunbury Hill. Here there was a spring, produced apparently by the uprise of water which had flowed underground in the limestone, and was here brought to the surface by an outcrop of slate. The valley then curves to the south-east and traverses the long tract of limestone which extends through the town to Fleet Street and the Strand (see map, Fig. 9, in the next chapter).

Why it took this direction is not easy to explain, but there may have been some reason why the original

watercourse on the high-level plateau found this course easier than by continuing southward over the ridge where Torre now stands. According to existent summit-levels the latter would seem to have been its most natural course, for the ground along Brunswick Square and East Street to South Street is only about 130 feet above the sea, while Waldon and Braddon Hills, between which the Fleet valley actually runs, are both about 200 feet high. It is possible that the Tor Hill conglomerate, which now occupies lower ground to the west of the limestone ridge, originally spread eastward over the limestone and formed an obstruction to the stream, as the same rock did near Marychurch.

On the other hand, it is possible that the original watercourse followed a nearly straight line from Upton to Fleet Street, and that its deflection round Sunbury Hill was a result of the gradual exposure of the tract of hard grits which extends from Thurlow Road to Castle Hill and across the top of Market Street. The stream may have found it easier to pass along the border of these grits than to cut its way through them.

Whatever were the causes which determined the original line of waterflow, it is clear that its general direction was south-eastward, and that the valley gradually acquired the character of a ravine as the stream cut its way deeper and deeper into the rock.

The final deepening of the passage between Braddon and Waldon Hills was probably accomplished during the time of high elevation of the land, subsequent to the period of the raised beaches, but preceding the subsidence which led to the formation of Torbay.

The depth of the Torre valley at its outlet has been discussed on p. 56, and as to the depth of the Fleet valley we fortunately possess a record by Mr. Pengelly, who described some excavations made for the foundations of houses in Fleet Street during the year 1867 at a point about 300 yards from the Harbour, where the surface level is about 20 feet above Ordnance datum (mean tide level). Here the limestone floor was found at a depth of a little over 17 feet, the deposits seen being as follow in descending order:—

Garden mould	about	2	feet.
Red clay like cave-earth. . .	„	5	„
Red clay enclosing angular masses of limestone . . .	„	3	„
Coarse sand with pebbles of quartz, slate, grit, flint, and limestone	over	9	„

The lowest deposit contained marine shells of recent species and pebbles perforated by sea-creatures; it is clearly a marine deposit, but might have been formed as a beach under existing geographical conditions when the lower end of the Fleet valley was an estuary. The record is interesting as showing us one of the last stages in the history of the valley, proving that the last subsidence carried the sea as far up as the top of Fleet Street. When subsidence ceased the process of filling up commenced, and the red clay is evidently material that has been washed down by heavy rains from the adjacent limestone slopes, burying the old beach and forming the floor of the old alluvial meadow which is known to have existed on this spot.

FIG. 9. GEOLOGICAL MAP OF THE TORRE AND ELLACOMBE DISTRICTS. Scale 4 inches to a mile.
Based on the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office.

For Index see p. 59.

CHAPTER VII.

The Eastern Valleys.

Contents.—The Ellacombe Valley. The Torwood Valley. The Bishopstowe and Ilsham Valleys; Ansteys Cove. The formation of Kents Cavern. The Meadfoot combe.

The country to the east of the Upton and Fleet valley is drained by several short valleys or combes, some of which present peculiar features and reveal a curious history. Two of these combes drain westward and open into the Fleet valley; one empties itself at the present time into Ansteys Cove, and the last, or Ilsham valley, opens directly into Torbay.

The first of these vales is Ellacombe, which is an oval basin-shaped depression lying between Plainmoor on the north, Warberry Hill on the south, and a spur of this hill on the east. From the inward slopes of these hills the rainfall is directed into the hollow of Ellacombe, the eastern part of which has a retentive subsoil of shaly slate. There is also a strong spring at the bottom of the valley opposite the Ellacombe Brewery, and all the water issuing from this is now conducted to the Brewery, though formerly it ran freely down the valley. Westward there is a tract of limestone (see map, Fig. 9), and through this the watercourse passes along the depression which runs

between Princes Road and Alexandra Road, but at the present time the actual watercourse is a covered drain.

Thence the original valley-floor seems to have passed below Ellacombe Green at a depth of 20 feet below the existing surface, for it is recorded in White's History of Torquay that "Ellacombe has undergone a remarkable change; the valley has been filled up more than 20 feet and now forms Ellacombe Green, while a new town with its church, chapel, and schools has taken the place of fields and gardens" (op. cit. p. 196).

Consequently, in trying to realize the features presented by this locality in its original condition, we must imagine the site of Ellacombe Green as a deep hollow with a short prolongation northward, as well as the longer one to the eastward, so that it received the rain-water draining off a part of Bronshill to the north, as well as that coming down the valley from the east. Springs also are thrown out at the base of the limestone tracts on each side, for these tracts appear to lie in basin-like folds, between which soft slate or "shillet" is brought up in an "anticline" or arched flexure.

From Ellacombe Green the valley passes southward along what is now Market Street, and at the same time it crosses two lines of faulting or vertical displacement without being in the least degree affected by them. By these two faults a narrow strip of the Warberry grits is brought up between the Ellacombe series of limestones and slates on the one side, and the main mass of the limestone (which underlies so much of Torquay) on the other (see Fig. 9). The southern line of fault crosses Market Street just above the Castle

Hill quarry, and can be traced thence to the north of Stentiford Hill, by the Western Hospital, to the corner of Lower Warberry Road, and across the Babbacombe Road by the entrance to Grist's Riding School.

The gully or ravine which has been converted into Market Street, has been cut straight across the outcrop of the grits and through the limestones into the Union Street valley. If this outlet did not exist, and if the limestones of Castle Hill and Stentiford Hill formed one continuous mass, as they originally did, the rainfall directed into the Ellacombe basin would convert it into a lake. There is no reason, however, to suppose that the Ellacombe basin ever was a lake, because the excavation of the basin or combe has probably gone on *pari passu* with the excavation of the ravine which drains it.

To understand the manner in which this basin-like combe has been formed, we must recur to what was said in Chapter IV. about the composite surface of Devonian rocks which underlay the newer deposits. The general structure of the Torquay and Babbacombe district is that of a broken arch or anticlinal flexure, but the centre of the arch is so broken down, and the outer parts are so faulted, that the beds do not succeed one another in their natural order. The breaking up of the arch may have been partly effected before Permian time, and partly afterwards, but in any case a fairly uniform surface was planed across the greater part of it before the deposition of the Eocene beds.

As in other cases, we may assume that the water-course which initiated the Market Street ravine was transferred directly from Eocene to Devonian, and

that its direction was determined by the slope of the original surface. Consequently it is very probable that the valley was commenced by a brook which ran over the Eocene cover from Plainmoor above Bronshill and Ellacombe Green, to join the Fleet river of the same early date; the course of the tributary stream over the site of Ellacombe being nearly from north to south.

The slates of Ellacombe are believed to belong to the Eifelian division which underlies the limestone, and, consequently, when a nearly level surface stretched across from Bronshill to Castle and Stentiford Hills, it is probable that very little slate was exposed on the north side of the Warberry grits, and that the surface over Ellacombe then consisted mainly of limestone. For some time, therefore, the brook would maintain a nearly straight course through the limestones and across the band of grits.

When, however, the brook had cut down through the limestones into the underlying shaly slates, the valley would then be widened in the direction of the highest outcrop of these slates, which is eastward; so that what was originally a small lateral combe extended itself in that direction, while the northern watercourse grew shorter and shorter. This is the history of many a larger river which suddenly turns from a longitudinal valley to pass through a transverse gorge; it is the accepted explanation of such cases and not a new theory of mine suggested to account for the formation of Ellacombe and Market Street.

It will, of course, be understood that the depth of the Ellacombe valley is in exact relation to that of the

Fleet valley. The former could not be deepened below the level of the outlet along Market Street, and the excavation of this proceeded *pari passu* with that of the Fleet valley; the final depth of the whole system of valleys having been reached before the last subsidence, which fixed the present relative levels of land and sea, brought the latter into Torbay, and drowned the lower part of the Fleet valley.

The Torwood valley does not call for much comment. It is merely a combe formed by the rain which flowed off the adjacent slopes of the Warberry and Lincombe Hills; but the position of its outlet into the sea, or rather into the ancient continuation of the Fleet valley, seems to have been determined by the existence of a dome-shaped anticlinal flexure bringing up the slates from beneath the limestone along each side of Torwood Gardens. Reference to the Geological Survey map shows that such slates underlie Torwood Street and Babbacombe Road, and the buildings on the north-west side of the latter as far as Torwood Mount. Similar slates are found along Torwood Gardens Road, but are cut off abruptly on the southern side, so that only half the dome remains.

This tract of slates, combined with another tract extending along Meadfoot Road, formed an easily eroded area, so that the rain flowing off the surrounding land soon made a watercourse along it. As in other such cases this was gradually developed into a valley, which became wider, longer, and deeper in proportion as the main valley into which it opened sank deeper and deeper into the land.

If this is the correct explanation of the Torwood valley, it probably did not come into existence until the Devonian rocks were entirely denuded of their cover, and it could not extend itself far to the north-east, because in that direction there was an older valley into which the rain from the eastern parts of the Warberry and Lincombe Hills was directed.

The Bishopstowe and Ilsham valleys were briefly described in an earlier chapter, and it was there stated that they seem to have been originally parts of one continuous valley: it is now our task to give a more complete account of the development and history of these two little valleys. One of the most interesting points in this connection is the remnant of an ancient watercourse which crosses the golf links on Wallshill and opens into the Bishopstowe valley through what is now Main's Nursery-garden. The northern end of this depression is abruptly truncated by the slope into Babbacombe Glen, and it is clear that the water which it carried must have come from ground which occupied the site of Babbacombe Bay, the land then probably continuing to rise in a north-east direction.

Babbacombe Glen has been formed partly by landslips and partly by the reversal of the rain-drainage along the course of this old valley, which was doubtless continued northward over the site of the Glen and drained all the plateau of limestone which once formed an eastern extension of Babbacombe Downs, uniting them to the northern extremity of Wallshill. At the present time neither it nor the Babbacombe branch of the Bishopstowe valley carries any permanent water;

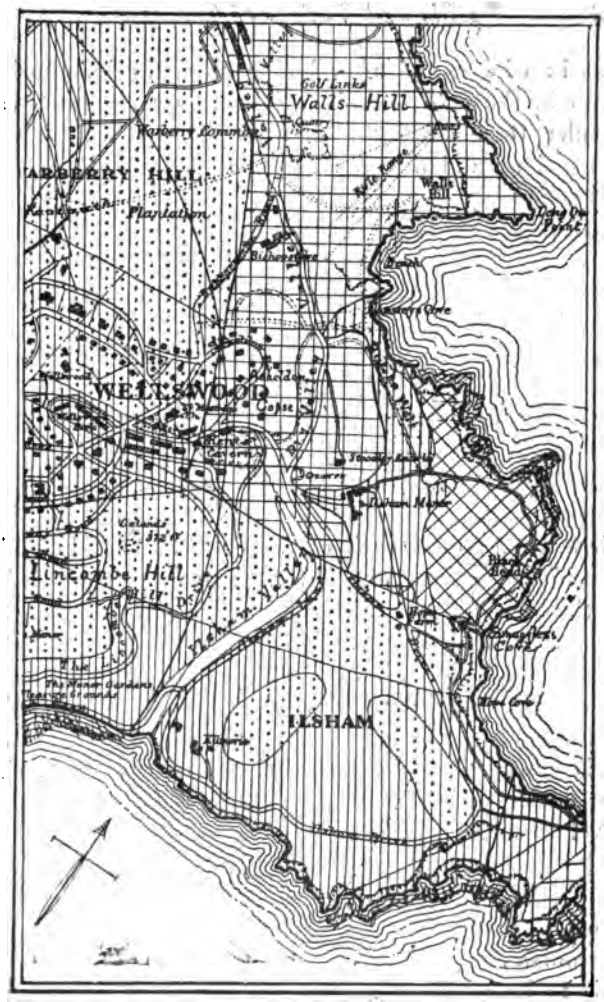


Fig. 10. Geological Map of Wellswood and Ilsham.
Scale about 3 inches to a mile. **For Index see p. 59.**

but in winter, and after long-continued rain, a spring rises in the field opposite Wallshill quarry, and the rivulet then flowing from this, passes down Bishopstowe lane and finds an outlet at Ansteys Cove (see map, Fig. 10).

If, however, we examine the surroundings of Ansteys Cove we shall soon be convinced that it was not the original outlet or continuation of this valley, but is merely a diversion of the natural line of drainage owing to the destruction of so much land by the sea, which has invaded the old valley at this point. If Ansteys Cove were on the site of the course taken by the continuation of the Bishopstowe valley, this would have been graded down to a steeper incline and deepened throughout its course, instead of opening directly on to the back of the Cove at a level of 140 feet above the sea. Moreover, there is another outlet at the higher level. Bishopstowe lane descends rapidly from a level of 200 feet, where it leaves the Babbacombe Road to 142 feet above the Cove; it then crosses the end of a depression which runs southward between the limestone tracts of Asheldon Hill and Stoodley Knowl. This ground is now a long strip of meadow-land, the surface of which is from 135 to 140 feet above sea-level (see map, Fig. 10).

It has been supposed that this depression was occupied by a narrow strip of Devonian slates, either brought in by faults or a continuation of the Upper Devonian shaly slates of Ansteys Cove, but I believe this to be a mistake. The limestones can be seen to pass beneath the soil of the meadow on each side, and I am informed that when a drain was laid through

Plate V. View across the Ilsham Valley to Anstey's Cove and Walls Hill Plateau.

this meadow a trench was dug to a depth of 15 feet in soft red earth without reaching either slate or limestone. This red earth was proved to a depth of 5½ feet in a pit dug for me in the middle of the field in 1906. It is of a lightish red colour, and much resembles the red earth so often found in limestone caverns.

It is evident, therefore, that this meadow overlies a buried valley or ravine, the bottom of which is more than 15 feet below the present surface. In all probability its floor consists of limestone which is continuous with the limestones of Asheldon Hill and Stoodley Knowl. This ravine is filled with the soil which has been washed off the slopes on each side of it since the time when the sea broke into the valley at Ansteys Cove and intercepted the Babbacombe rivulet.

Plate V. is a view of this old filled-up valley, taken from the Lincombe Drive and looking over the wood in which Kents Cavern is situated. The slope of Stoodley Knowl is seen to the right, and that of Asheldon Hill to the left, while between them lies the depression and meadow above described. Beyond it is the gap of Ansteys Cove and the level plateau of Wallshill with which Stoodley Knowl was continuous before the valley of Ansteys Cove was formed.

From these facts it is clear that if no outlet to the sea existed at Ansteys Cove, the water coming down by Bishopstowe would find its way along the buried valley above mentioned into the Ilsham valley. I have little doubt that this was its original course, and that Ansteys Cove only marks the site of another small tributary valley coming in from the north-east and draining the land which once existed between the limestone area on

the north and the igneous rock of Black Head on the south. The very existence of a bay between these two promontories suffices to prove that the space between them consisted of softer and more destructible rocks than those of the headlands, and we may safely assume that the southern part of this space was occupied by an eastward continuation of the shaly slates which form the cliffs the south side of Ansteys Cove. Such a tract of slate would naturally become a depression or valley which would receive the rain flowing off the surrounding ground, and perhaps also spring-water issuing from the limestone.

It is therefore my belief that there were originally two tributary valleys meeting at the head of Ansteys Cove; one coming down the western side of Wallshill and receiving all the rain which ran off the eastern side of Warberry Hill; the other coming from the east side of Wallshill and draining land which has been destroyed by the sea. The united waters of the little streams which made these valleys then ran southward along the buried valley east of Asheldon Copse, and constituted the head-waters of what may be called the Ilsham brook.

In these early times (Miocene or Pliocene) neither the Wellswood spring nor the deep gully in front of Kents Cavern could have been in existence, for the water-level in the limestone must then have been much higher than it is now, and the eastern slope of Asheldon Hill must have been continued southward over the site of this gully, so as to pass gradually into the slope of Lincombe Hill. It was doubtless while such conditions prevailed that Kents Cavern was slowly eroded out of

the limestone; it was then a subterranean waterway through the continuation of Asheldon Hill, and its opening was probably some 50 yards to the eastward of its present outlet, the water which it carried helping to swell the Ilsham stream.

We must of course picture this stream as running at a level corresponding to the bottom of the dry valley above mentioned, *i.e.*, about 120 feet above the present sea-level. Assuming that the valley-way continued southward with a fairly gentle slope, its level to the west of Kilmorie may have been about 60 feet above Meadfoot beach, and thence, of course, it continued to run over land that has been destroyed by the sea during the making of Torbay.

It is easy to see that another small tributary must have come in from the eastern side by Smugglers Cove and Hope Farm, carrying the rainfall from the land which lay between Black Head and Hopes Nose. This valley has been excavated in a tract of red slates which are faulted against the diabase of Black Head and bounded on the south by slates capped by patches of hard grit which form a hill rising to over 300 feet above the sea.

Lastly, it is noticeable that the southern slope of Lincombe Hill above Meadfoot is not a cliff, but has more of the aspect of a natural valley-side, contrasting strongly with the precipitous cliffs below and east of Kilmorie. Meadfoot, moreover, passes westward into the hollow between Lincombe Hill and Daddy Hole Plain, along which the Meadfoot Road is carried. Thus it seems very probable that Meadfoot is the head of another short tributary combe which was continued

along Meadfoot beach and opened eastward into the main Ilsham valley opposite Kilmorie; Lincombe Hill being the northern side of the combe, while the southern side has been destroyed and carried away by the sea. The Shag Rock is doubtless a relic of the ridge which formed the south side of this valley in continuation of Daddy Hole Plain; the inroads of the sea having practically ceased when so much of the valley had been invaded and before its northern side had been reduced to the form of a cliff.

The considerations above set forth lead us to infer that the existing Ilsham valley is only a deeply incised portion of a much longer valley which carried off the rainfall of this corner of Devon at a time when the land extended much further eastward and southward than it does now. At that time Torbay was an undulating tract of land, and the Ilsham valley continued its course southward or south-eastward till it opened into the main valley of the Torbay drainage-area.

During the subsequent time of subsidence, when Torbay was gradually formed by the inroads of the sea, the main valley was destroyed and the courses of all its tributaries were shortened. In the case of the Ilsham valley the coast line was gradually cut back till the sea reached its present position at Meadfoot, and also broke into the valleys of its eastern tributaries, completely destroying the valley of Ansteys Cove and diverting the drainage so as to shorten the Ilsham valley at both ends. The old valley has, in fact, been both beheaded and curtailed.

This gradual recession of the coast-line not only carried the sea-level farther and farther inland, but

obliged the stream flowing down the Ilsham valley to reach sea-level in a continually lessening distance. In other words, the advance of the sea-level forced the little stream to descend through a greater height in a given horizontal distance. Thus we have seen that when the valley was complete its floor must have passed some 60 feet above Meadfoot beach, whereas its present outlet is only a few feet above that beach.

The whole remaining section of the valley from Wellswood and Asheldon Copse has evidently been gradually excavated and graded to a steeper slope by the effort of the rivulet to accommodate itself to the changing base-level. The depth to which its lower portion has thus been cut may be judged from the view given on Plate III., which looks southward to its mouth, and also to some extent from Plate I., which looks across the head of it to Lincombe Hill.

It would seem that at this time the rain running off the eastern part of Wellswood was excavating the gully or combe which curves round in front of Kents Cavern and along which the Ilsham road is carried. The deepening of this combe would intercept the water draining southward through the limestone of Asheldon Copse, which water had previously found its way through Kents Cavern, thus it is probable that Kents Cavern was gradually drained and left dry when the Wellswood spring came into existence.

The reader may well ask how this valley-making was done, considering the feebleness of the modern rivulet. The answer is that in pre-historic times (*i.e.*, in the Pleistocene epoch), the rainfall and snowfall were much heavier than they are now, and consequently

much more water was directed into this valley. It is well known that the melting of much snow, or the continuance of heavy rain for three or four days, will cause freshets, and these will deepen a valley in a few hours more than the ordinary stream can effect in the same number of years.

I think it will now be understood how the Ilsham valley came to be so deeply cut into the land, and why its present floor is so far below the level of the dry valley which leads to Ansteys Cove, and below that of the other lateral valley by Hope Farm; for both these belong to an early stage in the formation of the valley-system, and both ceased to carry water when the sea broke into their upper ends.

CHAPTER VIII.

THE DEVELOPMENT OF THE HILLS.

Contents. — HILLS WHICH ARE REMNANTS OF AN ANCIENT PLATEAU. THE WARBERRY AND LINCOMBE HILLS ARE EXCEPTIONS. ISOLATION OF HILLS BY EXCAVATION OF VALLEYS. VANE HILL A BULWARK OF THE HARBOUR. ISOLATION OF WALDON, TOR, YADDON, AND LUMMATON HILLS.

The hills of Torquay were mentioned on the first page of this volume, and it was stated that they owed their existence as eminences to the removal of the rock-material which originally united them to one another. To a very large extent hills are the consequences of valley-erosion, for the valleys are the places from which the greatest quantity of material has been removed, while the hill-tops are the spots which have suffered least in the general detrition of the country. The development of the hills can therefore be much more easily understood after that of the valleys has been explained.

Most of the hills in and around Torquay seem to be in reality only isolated remnants of an ancient plain or plateau which slopes very gradually from north to south. There is proof that this plain was formed after most of the Permian deposits had been removed from the Torquay area, and in all probability it was part of the surface developed out of the older rocks during the

long interval which elapsed between the formation of the Chalk and that of the Bovey (Eocene) beds (see p. 27). During all this time the West of England was land, and was exposed to all the detritive effects of a copious rainfall, while at its close the land sank beneath the shallow waters of the lagoons and swamps in which the Bovey beds were deposited. By the filling up of these lagoons, and by continued subsidence, still wider plains were formed, on which, when finally upraised, our present river-system began to be established.

How the local valleys have been carved out of the higher plain has been described in the preceding chapters, and we have now to consider how the hills have been developed out of the tracts which lay between the valleys formed by the watercourses. In the first place it is necessary to distinguish carefully between the higher plain formed by the upraised surface of the Eocene deposits, and the older, less even surface on which these deposits rested. The former has been entirely destroyed, but portions of the latter remain and are still recognisable as plateaus or flat-topped hills.

The truth of this last statement will be apparent from a consideration of the summit levels of the country around Torquay. Reference to the Ordnance maps, on the scale of six inches to the mile, will show that inside the two watershed ridges (see Fig. 1) there are few hills which rise above 350 feet; Warberry and Lincombe Hills being the chief exceptions. Most of the other heights do not reach the level above mentioned, and if we could place an immense aeroplane above them in such a position that it sloped from 360 feet

on the north to 270 feet on the south, none of these hills would touch it.

Thus, commencing on the northern side, we have the flat-topped hills to the east and west of Barton, the eastern one being known as Mincent Hill (see map, Fig. 6). These hills are obviously portions of a plateau which has been intersected by a watercourse; both are about the same height (between 330 and 340 feet, see Fig. 7,) above sea-level, and the western hill merges into the ground along which the Barton Road runs, where the level rises gradually from 330 feet to 360 feet at the foot of Barton Cross Hill.

South of these Barton hills we find Lummaton Hill, the summit of which is not marked on the Ordnance map, but is probably about 340 feet, and it requires no great stretch of the imagination to see that this limestone hill was once continuous with the Barton hills, its separation being obviously due to the existence of the intervening band of Permian clay, which is faulted against the Barton limestone, and has yielded to the erosive action of the rain more rapidly than the limestone.

The southern part of Lummaton Hill slopes gradually to less than 300 feet, and is bounded on the east by the valley of the Barton brook, but beyond this the ground rises again to 334 feet in the northern part of St. Marychurch (at the corner of Petitor Road). Here the Permian conglomerate enters into the structure of a plateau which comprises the greater part of the area on which Marychurch stands; reaching eastward to Petit Tor which is a little knoll of limestone rising to between 330 and 340 feet above the sea.

From Marychurch southward and south-eastward a large tract of nearly level ground stretches away over Plainmoor, through Babbacombe to the foot of Warberry Hill by "The Quinta," and along the eastern side of that ridge over Wallshill and Wellswood. Along this tract of ground the surface undulates slightly in consequence of the detrition and erosion to which it has been subjected, but on the whole there is a gradual fall from north to south, *i.e.*, from over 300 feet in Marychurch to 267 feet on Wallshill, and 268 feet on Stoodley Knowl, and 254 feet in Wellswood.

West of Marychurch again there are two flat-topped hills which are obviously isolated remnants of the same plateau. These are known respectively as Daison Hill and Windmill Hill, the older and more correct name of the latter being Yaddon or Yeadown Hill. Their summits are nearly level, and do not rise above 320 feet, and like the similar twin hills at Barton, they have been separated from one another by the excavation of the intervening valley (see p. 65 and Plate VII.) Reference to the geological map (Fig. 8) will show that they are actually parts of one mass of limestone, and that Daison Hill is still united to the Marychurch plateau by a ridge which nowhere falls to less than 275 feet.

To the south of the Yaddon-Daison plateau the ancient surface has been practically destroyed by the long-continued action of rain and running water acting on a tract composed of several kinds of rocks, and out of it has been carved an irregular series of hills, ridges, and spurs, none of which rise much above 200 feet. The highest and most northerly of these eminences are

PLATE VI. THE BABBACOMBE PLATEAU WITH WARBERRY HILL IN THE DISTANCE.

Stantaways Hill (248 feet) and Upton Hill (212 feet). Torre Hill does not rise above 180 feet, and Waldon Hill is believed to be about 200 feet above sea-level, but on Stentiford and Braddons Hills the ground rises to between 220 and 230 feet. Still further south, the top of Vane Hill is about 210 feet, and the plateau of Daddy Hole Plain is just above 200 feet.

The development and isolation of these hills will be referred to later on. They are only mentioned now because they are all so nearly of the same height and are so evidently the reduced and isolated remnants of a plateau which once extended as a continuous surface above their summits, a surface which cannot have been less than 250 or 260 feet above the existing sea-level, where it passed over Waldon and Vane Hills.

I have thus justified my initial statement that most of the hills around Torquay are only isolated portions of an ancient plateau which either originally possessed or has since acquired a slight but definite inclination from north to south. We have now to deal with the hills which did not form part of this plateau, but must have risen above its surface as a contemporary tract of high ground (see Plate VI.)

This tract of ground appears to have included what are now three separate hills—Warberry Hill, which rises to 448 feet, Lincombe Hill (called Oxlea Hill on the Ordnance maps) which just reaches the height of 400 feet near St. Raphael's Home, and, lastly, the nameless hill above Kilmorie, which for convenience we may call Kilmorie Hill, the highest part of this being 353 feet. All these hills consist of Lower Devonian rocks, and beds of hard grit and sandstone enter so largely

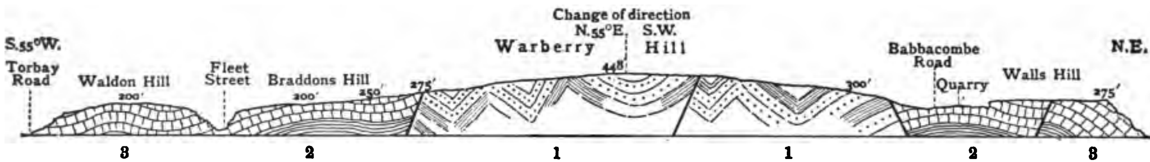


FIG. 11. SECTION FROM WALDON HILL THROUGH WARBERRY HILL TO WALLS HILL.
Distance about one mile and two-thirds.

3. *Limestones.* 2. *Shaly slates.* 1. *Grits and slates.*

N.B.—The flexures of the Warberry Beds are diagrammatic, and are not meant to be accurate in detail.

into their structure that, if there were no evidence of a surrounding plateau, we might suppose it was the hard and siliceous nature of these grits which resisted the detritive agencies and accounted for the pre-eminence of the hills.

It is quite possible that the special characters of these beds had much to do with the survival of the tract as a ridge during the time when the surrounding country was reduced to the condition of a plain. At the same time we have proof that a portion of the same series of beds was planed down to the level of the plain, for a strip of them, let down between nearly parallel faults, runs through Stentiford (or Happaway) Hill and Castle Hill to Thurlow Road, no part of this band rising above the level of the limestones on one side or the other.

Fig. 11 is a section through Warberry Hill, showing the manner in which it is flanked on each side by remnants of the plateau-area and the faults by which the Lower Devonian beds are here limited. Plate VI. also shows how it rises above the Babbacombe plateau.

It seems clear that owing to the set of the local currents, or to some other cause, Warberry Hill escaped the levelling action of the sea by which the plateau was fashioned, and that it formed part of a continuous tract of high ground which rose as an island above the shallow waters of the Eocene lagoons. It was only for a time, however, that it could have existed as an island, for it must have been completely buried beneath the deposits which were formed in these lagoons during the Eocene subsidence.

The burial of the island-ridge might be inferred from the great thickness of the Eocene deposits in the Bovey Basin (more than 500 feet), but we have positive proof of the burial of the south-eastern part in the fact that it is traversed by the deep valley of the Ilsham brook. The course of this brook could not have been determined after the country had acquired its present configuration, because the ground where the brook now rises (in Wellswood) is lower than the ridge through which it passes near Kilmorie; it must, therefore, have been established on a surface which sloped from north to south and passed above the level of the Kilmorie ridge.

Let us now approach the subject of the Torquayan hills from a different point of view, and trace their gradual development out of the ancient plateau, and the hill or island which rose above it, after the land had risen again to a higher level and the subaërial agencies had begun their work of erosion and detrition upon the covering mantle of Eocene clays and sands.

Let us commence with the Kilmorie and Lincombe Hills, since they illustrate very clearly the gradual process of hill development. The tract of land, out of which these two hills have been carved, consists, for the most part, of the series of slates and grits which are known as the Meadfoot Beds, but the higher parts of the ground between 250 and 400 feet include more massive beds of hard greenish grit which belong to the Warberry group of beds (see map, Fig. 10). It must not be supposed that these grits are merely horizontal cappings to the hills; they are probably deeply infolded with the Meadfoot Beds, but they are less easily

disintegrated than the latter, because they consist largely of quartz-grains and form more solid beds than the slates.

The first stage was the establishment of a watercourse on the surface of the Eocene deposits above what may be called the Asheldon and Ilsham valley. This would be gradually deepened till it formed a complete separation between the tracts which lay to the west and the east of it, *i.e.*, the Warberry and Lincombe Hills on the other hand, with Stoodley Knowl, Black Head, and Kilmorie Hill on the other. As soon as any considerable area of Devonian rocks had been exposed to the action of the atmosphere, the development of these hills would commence as a necessary consequence of the different hardness of the rocks which compose the district (see map, Fig. 10). The softer and more friable strata would be broken up by frost and carried away by rain much more rapidly than any of the other rocks, limestone, diabase, and grit, and the grits as the least destructible would be left to form the highest ground.

The separation of Lincombe Hill from Warberry Hill is due to the excavation of the Torwood valley in the manner already described (see p. 75), and to the gradual lowering of the local watershed between the Torwood and Wellswood valleys, till it came to form a col or depression connecting one with the other.

On its southern side Lincombe Hill slopes down to Meadfoot, which is believed to have been a valley before it was invaded by the sea (ante p. 81); while on the north-east side the hill is bounded by the Wellswood limestone which has yielded to the chemical and

mechanical action of water much more rapidly than the grits which are faulted against it.

Thus, Lincombe Hill owes its isolation to the erosion of the valleys which surround it, but its shape and height are largely due to the presence of the hard grits, for if it had consisted wholly of the more shaly beds of the Meadfoot group it would not have been so high nor so compact a hill.

The isolation of Warberry Hill needs little further elaboration, for it is assumed to be the northern end of the ridge which originally stood out above the level of the surrounding plain. On the east and west it is bounded by denuded and dissected portions of this plain; on the north-west by Ellacombe, a deep hollow which has been excavated out of the same plateau, and on the south it is separated from Lincombe Hill in the manner above described.

The superior height of Warberry Hill is probably due to its having been originally the highest part of the isolated ridge. Its present height of 448 feet is about 160 feet above the average level of the plateau lying to the north and east of it, but we may be sure that the summit-ridge has been greatly lowered by the action of the weather during Miocene, Pliocene, and Pleistocene times. Its actual height above the sea has, of course, varied much during these periods: thus, when the raised beach of Hopes Nose was being accumulated, the land lay lower by 25 feet than it does now, while at the later period when forests grew in all the valleys, which are now buried beneath the sands of Torbay, the land was higher by about 60 feet, and the summit of Warberry Hill must then have been 500 feet above the sea.

Let us next consider the development of the more western hills, which have hitherto been considered only in connection with the former existence of a continuous plateau. Their isolation has been accomplished by the same process of valley-making and of differential erosion as was indicated in the case of Lincombe Hill.

Little need be said about Vane Hill and its continuation onto Daddy Hole Plain, for the limits of the hill on the inland side correspond very nearly with the boundary of the limestone, the ridge being isolated by the Torwood valley on the north, and by the Meadfoot valley on the north-east. It may, however, be pointed out that the existence of a mass of limestone in this position is a very important feature in the geography of Torquay, for if the limestone had not been brought down to so low a level by the sharp curvature which is so noticeable at "London Bridge" and in the Magwinton Rocks, this tract would have been composed of soft Eifelian shale. This shale could not possibly have withstood the attacks of the sea as the limestone has done, and the coast would long ago have been cut back into a nearly straight line from the Meadfoot shore to Torquay harbour. There would then have been no natural harbour at Torquay, and bearing this in mind we ought, as inhabitants of Torquay, to regard Vane Hill with much respect as the main bulwark and guardian hill of the Town.

Waldon Hill again is also very obviously a hill because it is part of a tract of high ground which lies between two valleys; that of Fleet Street on the one side, and that of Torre Abbey on the other. Moreover, it is easy to see how it originally terminated southward

before the sea reached its foot and quarried out the present cliff face, for, as mentioned on p. 56, the Torre valley curved round below it, and must have joined the Fleet valley somewhere below the bend of the Princess Pier, and Waldon Hill must then have sloped down steeply to this point of junction.

The hill consists of limestone, the mass of which was originally continuous with that of Braddons Hill, the isolation of Waldon Hill and the steepness of its eastern side being due to the excavation of the Fleet valley. On the western side Permian sandstone and conglomerate are faulted against the limestone, and these beds, yielding to the disintegrating and erosive power of rain more rapidly than the limestone, have been worn down into the gentle slope which extends from Sheddon Road and Crofton Road, westward to Torre Abbey.

Waldon Hill rises to about 200 feet above the sea, but sinks gradually northward into the Torre Hill ridge, its limestones being separated from those of Torre Hill, by a narrow strip of green and grey slates. It is doubtless due to the outcrop of these more destructible beds, that the depression between the two hills is due, the outcrop of the slates having been worn down into a kind of pass along which Tor Church Road has been carried.

Torre Hill, in its primitive and natural condition, must have been much more conspicuous and picturesque than it is now. There can be no doubt that it was from this prominent limestone rock or "tor" that the old village of Torre took its name, for the old parish church is not far from the foot of the hill. It is a great

Plate VII. View of Yaddon Hill and Combe Valley from the North.

pity that Torre Hill could not have been enclosed within the grounds of a single house or at most two residences, instead of being quarried at both ends and encircled by so many closely-set houses that the actual outline of the hill is now completely obscured.

The summit of the "Tor" lies within the grounds of Lauriston Hall and rises to about 180 feet above the sea, but only small portions of it remain in their pristine condition. In former days it must have been a conspicuous eminence when viewed from any point of the compass, and even now it stands up boldly when viewed from the north-east (Upton Road). The rock consists of a massive whitish limestone with a compact structure which has enabled it to resist detrition, and it forms part of a small tract of limestone which appears to be bounded on three sides by faults, while on the east it descends to the deep valley of the Fleet.

We may now pass to the twin hills of Yaddon and Daison, north of Upton, and may notice how entirely their relative elevation is due to circum-detrition, *i.e.*, to removal of surrounding material. In the first place, the two would have formed one compact flat-topped hill or plateau, if the deep Combe Valley had not been cut through the limestone mass so as to divide it into two parts (see Fig. 12 and Plate VII.) Daison Hill is bounded on the north-east by a tract of shale, through which runs a little watercourse, and on the south-east by another valley, excavated partly in limestone and partly in shale, by Daison Farm and Hill Park. Yaddon Hill is similarly limited on the north and south by depressions which have been formed

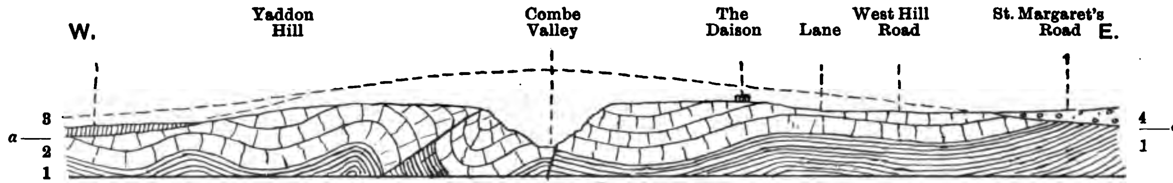


FIG. 12. SECTION ACROSS YADDON AND DAISON HILLS.

Scale (vertical and horizontal) 6 inches to a mile (880 ft. to inch)

4, *Permian conglomerate.*
3, *Permian clays.*
2, *Devonian limestone.*
1, *Devonian shale* (*Eifelian*).

N.B.—The broken line indicates the probable continuation of the base of the Permian Beds before the planation of the surface in Eocene time.

The flexures west of Combe Valley are diagrammatic.

by rain, making its way off the plateau into the Combe and Upton valley.

At all these points the two hills are bounded by valleys which have been carved out of the denuded and planated surface of the Devonian rocks during Tertiary time, by the action of frost, rain, and running water. It is only on the western side that the still older pre-Permian surface of the limestone is preserved; on this side the old dolomitised surface of the rock passes below the red Permian clays, and the western slope of Yaddon Hill is probably part of a pre-Permian slope, the upper or eastern part of which has been truncated and levelled off by the erosion of Eocene time. This is illustrated by the diagram Fig. 12.

The Permian clays must have been banked up against this old slope, and have thinned out against it, as indicated by the broken line, while the conglomerate must have extended completely over the limestone above the continuation of this line.

Lummaton Hill, still further north, presents practically the same features; it is a hill because less material has been removed from it than from the ground around it. Its western border is a pre-Permian slope, but its three other sides are bounded by valleys which have received their final moulding in late geological times. The manner in which the Permian clays wrap round the northern end of the hill illustrates and confirms the statement above made as to the eastward extension of these clays over Yaddon Hill and their overlap by the overlying conglomerate; for the northern end of Lummaton marks the dying out

of the Torquay anticline, and if the limestone had not been brought up again at Barton by a post-Permian line of fracture, Lummaton would have been the most northerly exposure of Devonian rock in the Torquay district.

END.

"FLEET" PRINTING WORKS, TORQUAY.

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